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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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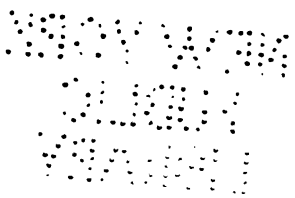

THE CHEMICAL NEWS.

VOLUME XXXV.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 893.—JANUARY 5, 1877.

ON THE

ESTIMATION OF PHOSPHORUS IN THE FORM OF PHOSPHO-AMMONIO-MOLYBDIC SALT, $(5H_4NO,2P_2O_5)+(5H_2O,10MoO_3)$.

By SERGIUS KERN, St. Petersburg.

EGGERTZ gives in his Swedish work, "Om Kemisk, profning af Tern, Ternmalmer, och Braennmaterialier," a method of quantitative analysis of phosphorus which is based on the precipitation of phosphorus in the form of phospho-ammonio-molybdic salt by a mixture called "molybdic solution," prepared by dissolving 100 grms. of molybdic acid in 422 c.c. of ammonia, 0·95 specific gravity, and mixing this solution with 1250 c.c. of nitric acid, 1·20 specific gravity. This method he employed in analyses of iron and steel, and since then a great many analyses have been executed by this method in laboratories of iron works. Working now almost entirely with products of such works, and analysing Bessemer and crucible steels for phosphorus, I find that the method as designed by Eggertz must be altered in details. The author of this method advises to proceed as follows for the quantitative analysis of phosphorus:—

1 grm. of the iron specimen is dissolved in 12 c.c. of nitric acid; the liquor is next evaporated on a sand-bath to dryness; the residue is dissolved in 5 c.c. of aqua regia, and to the solution 4 c.c. of water is added. The liquor is filtered from the silica; the filtrate must not be more than 20 c.c. From this solution the phosphorus is precipitated by about 30 c.c. of molybdic liquor, the preparation of which has been already mentioned. The solution is left for 15 hours in a warm place, and is then filtered. The precipitate containing phosphorus is washed by cold water acidulated with one per cent. of nitric acid. The yellow precipitate is dried on the filter at 100° in an air-bath and weighed. This precipitate contains 1·63 per cent. of phosphorus. On this process I wish to make some remarks—practical remarks, I had better say.

1. For dissolving iron it is better to use aqua regia, because nitric acid is not such a powerful agent for decomposing the whole of the organic matter which is often found in irons; the presence of this was found to prevent the precipitation of phosphorus by the molybdic solution.

2. The process of filtration and washing of the yellow precipitate must be executed very rapidly, because otherwise a certain quantity of the yellow precipitate is dissolved, and passes through the filter with the solution. Many trials were made, and it was always found that a small quantity of the precipitate passed into solution. In this case a lower percentage of phosphorus is obtained; this gives incorrect results in analysing steels and irons, and such materials where a small amount of phosphorus not estimated may give faulty results in the classification of the materials.

3. Eggertz advises to wash the yellow precipitate with water acidulated by nitric acid, and dry it on the filter at 100°. In practice this operation is nearly impossible, firstly because the precipitate is slightly soluble in acidulated water, secondly because a small quantity of the acid always remains on the filter, from which the filter when dried is always a little rotten; this fact also influences the percentage of phosphorus calculated.

The best method was found to be the following:—

1 grm. of the specimen is dissolved in 20 c.c. of aqua regia, and the phosphorus is precipitated by Eggertz's method; the resulting yellow precipitate, separated from the solution, is dissolved on the filter in ammonia, and in the filtrate obtained, slightly acidulated by hydrochloric acid, the phosphorus is precipitated in the form of phospho-ammonio magnesic salt $[Mg(NH_4)PO_4]$ by "magnesium mixture," prepared by dissolving 1 grm. of $MgSO_4$ and 1 grm. of NH_4Cl in 8 c.c. of water mixed with 4 c.c. of ammonia. The precipitation is finished in 15 to 20 hours; the precipitate is filtered from the solution, washed with water containing half a per cent. of ammonia, and first gently heated in a platinum crucible till free NH_3 and H_2O are evaporated; the crucible next is ignited for 30 to 40 minutes, and the received $Mg_2P_2O_7$ is weighed. This salt contains 13·51 per cent. of phosphorus.

This combination of Eggertz's method with the old one gives very exact results in analyses of irons and steels.

Obouchoff Steel Works, St. Petersburg.

NEW APPLICATIONS OF GLYCERIN IN THE LABORATORY.

By A. H. CHURCH, M.A.

FOR some time past I have used glycerin for preventing the adhesion of vulcanised india-rubber tubing to the inlet pipes of Bunsen and other gas-burners. A drop or two smeared on the parts in contact prevents both surfaces from suffering those changes which give rise to such continued annoyance in the laboratory. The glycerin should be pure.

One of the most serious drawbacks to the use of paraffin lamps for microscopic and other purposes is the perpetual creeping out of some of the hydrocarbon through the cement wherewith the metal burner is fixed to the glass reservoir. If this cement be soaked with glycerin before oil of any kind be introduced into the lamp this annoyance does not occur.

ON THE SPECTRA OF LIGHTNING.

By J. W. CLARK.

ANOTHER opportunity of observing the spectrum of forked lightning having occurred, the following observations were made:—Out of 26 observations, 11 spectra showed bright lines of oxygen, nitrogen (at times apparently also of hydrogen), 7 more were uncertain on account of their being too faint, and the remaining 8 were continuous, but without lines. A few more spectra resembled those previously described (CHEMICAL NEWS, vols. xxx. and xxxii.), in which *parts* of the spectra were alone visible, particularly the red end, but sometimes the space between the solar lines D and F or D and E was seen of a uniform and almost white colour (CHEMICAL NEWS, vol. xxxii.), which now seemed to be possibly due either to the flash not being sufficiently bright or to its not being in the direction of the axis of the spectroscope. Previously, however, the same appearance was observed with very bright flashes. The density of the air in which the discharge takes place will probably influence the nature of the spectrum, and the amount of aqueous vapour may also affect it, as determining the amount of incandescent hydrogen, which, as is well known, shows remarkable changes in its spectrum when subjected to varying pressure and temperature.*

THE ANALYSIS OF SOAP.

Weighing.—In all methods usually given in text-books the analyst is directed to weigh out for each operation small portions (1 to 5 grm.) of the sample. This plan is to be avoided, and for two reasons:—(1) Soap is extremely variable in composition, and considerable variations are possible even in the same sample; (2) It is perpetually losing water by evaporation from its surface. As the soap is usually weighed in the form of thin shavings, the surface exposed is, in relation to the weight taken, very considerable. These two sources of inaccuracy are obviated by weighing out for the analysis a section cut through the bar at right angles to its length (60 to 80 grms.), dissolving in distilled water, and making the volume up to 1000 c.c. (in the cold); 50 c.c. of this solution are measured off for each operation. It should be observed that as some of the alkaline salts of the fatty acids separate out from the solution on cooling it must be well mixed, by agitation, previously to drawing off each 50 c.c. The several operations are conducted as follows:—

I. *Total Alkali.*—50 c.c. of the solution are diluted to about 200 c.c., the liquid is coloured faintly with eosine, and standard acid is run in, taking care to stir briskly with a glass rod. The neutral point is extremely well marked by the sudden decolorisation of the whole. The cause of this apparent destruction of colour is the union of the fatty acids with the eosine at the moment of their complete separation from the fluid.

II. *Uncombined Alkali.*—50 c.c. are added to 300 c.c. of a saturated solution of common salt, which must be, of course, neutral to test paper, and the volume made up to 400 c.c. The neutral alkaline salts of the fatty acids (*i.e.*, true soap) are precipitated; any excess of alkali present remains in solution; this is determined in an aliquot part of the filtered solution; the filter must not be moistened previous to filtration; from this the total uncombined alkali is calculated, and subtracted from the *total alkali* already found. Then the *combined* and *uncombined* alkali are determined.

III. *Fatty Acids.*—50 c.c. of this solution are introduced into a stoppered separating funnel, decomposed with excess of acid and agitated with carbon disulphide until the liberated fatty acids are dissolved. The disulphide solution of the fats is drawn off into a tared flask; the aqueous solution is washed once or twice with small portions of disulphide, the whole of which is then separated from the fats by distillation. The fats are purified from the last traces of CS_2 by heating the flask for a short time at 100° C.; the weight, after cooling, less the tare, gives the weight of the fatty acids. Ordinary ether may be used in place of the CS_2; it has, however, the disadvantage of retaining small quantities of water, and, therefore, aqueous acids, which must be driven off at the end of the operation by exposing to a temperature of 100 to 120° C., until the weight is constant. Further, the ethereal solution will be the upper stratum, and is, for obvious reasons, not so easily to be manipulated as the bisulphide solution, which forms the lower layer.

Note.—A moment's consideration of the following equation representing the decomposition of sodic oleate by HCl:—

$$2\left\{\begin{matrix}C_{18}H_{33}O\\Na\end{matrix}\right\}O + 2HCl = 2NaCl + 2\left\{\begin{matrix}C_{18}H_{33}O\\H\end{matrix}\right\}O.$$

will make it evident that while the fatty acid is present in the soap in the form of anhydride, it is separated and weighed in the course of analysis as hydrate. A correction must, therefore, be applied based upon the fact that 282 parts oleic hydrate = 273 parts oleic anhydride—*i.e.*, the weight of the fatty acids is to be multiplied by the decimal fraction 0·97.

In the case of the "Olein" soaps of commerce a very rapid and tolerably accurate estimation may be made in the following way:—50 c.c. of the solution are decomposed with HCl in a small flask, the neck of which is long and narrow, and graduated in c.c., and so much water added that, upon heating in the water-bath, the separated oil will rise into the neck and fall entirely within the graduated portion. The heating must be continued, with occasional tapping of the flask, until the whole of the fat has been separated and has risen into the neck. The flask is allowed to cool, and when cool the volume of the oil is read off. This quantity, multiplied by the specific gravity of the oil, gives its weight. The specific gravity (which I have almost always found to be 0·9) may be determined by pouring off a small quantity into a capsule; (a second reading will give the volume taken), and weighing it; the weight divided by the volume is the required specific gravity.

IV. *Water.*—If the purity of the sample has been ascertained this constituent may be calculated by difference. The direct estimation is effected by evaporating 50 c.c. of the solution to dryness on the water-bath (finally in the air-bath from 100° to 120° c.) in a weighed dish. The residue is anhydrous soap; from its weight the percentage of water in the soap may readily be calculated. It may be observed that the usual method, which consists in the exposure of the soap, previously cut into thin shavings and weighed, to the temperature of boiling water until it ceases to lose weight, is inaccurate, as it fails to drive off the last portions of water (1 to 2 per cent), which seem to have contracted a stronger union with the soap.

V. *Mineral impurities and unsaponified fat* may be detected by taking the dried soap from the preceding operation, dissolving in strong alcohol, and filtering through a funnel heated by means of a jacket of hot water. *Mineral impurities* remain upon the filter as an insoluble residue, the weight of which is readily ascertained. The alcoholic filtrate is evaporated with successive additions of distilled water; by these means any unsaponified fat or resin is separated from the soap, which, of course, remains in aqueous solution. This solution may be used for I., II., or III. The mineral impurities may be examined qualitatively after drying and weighing.

C. F. C.

The Laboratory, Owens College,
December 15, 1876.

* See Wüllner, "Lehrbuch der Physik," Bd. *II.*, s. 244, and Schellen "Spectralanalyse," s. 167.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from, vol. xxxiii., p. 245.)

The Sulphur Industry of Sicily.
By Dr. ANGELO BARBAGLIA.

The Work in the Sulphur Mines.—The miners who raise the sulphur ores are called *picconieri*, and work under the direction of foremen known as *capo mastri*. At the head of the establishment, immediately under the proprietory, there is now generally a scientifically-trained mining engineer. The duty of the picconieri is to split out the sulphur ore from the veins, and to break it up, which is done with heavy hammers (*piccone*), weighing about 6 kilos., and sharpened on one side to facilitate the splitting. Gunpowder is very rarely used except where the gangue consists of the hardest limestone. The adits follow the direction and inclination of the veins, and branch out at places where the ore is rich and easy to work. In this manner are formed a series of spaces known as *gallerie* or *caverne* of every form and size opening into each other in the most various manner. The breadth of these galleries varies from 2 to 2½ metres; their height fluctuates and depends to a certain extent on the thickness of the beds, and especially on the hardness of the rock enclosing the sulphur ores. Where this rock is soft it would be dangerous to give the galleries a greater height than 2 metres, and to prevent accidents the sides are often supported by walls either run up dry or cemented with gypsum.

The 14 to 15 million quintals of ore furnished yearly by the 250 solfares of Sicily are almost exclusively transported by human labour. Both in the galleries and up to the mouth of the pit the mineral is carried by thousands of boys of from eight to ten years old (*manuali*), who convey the ore on their backs or shoulders. Only when the mine attains a depth exceeding 100 metres this method of transportation is abandoned both in accordance with the sanitary laws and from economic considerations. At such depths, and especially when water has to be removed, machinery must be brought into play or the mine abandoned. In such cases horse-galleries (*gallerie di carreggiatura*) have long been employed in Sicily, but if water has to be lifted vertical shafts (*pozzi verticali*) become necessary.

Hitherto horse or cart galleries have only been introduced in four solfares, those of Montagna Vecchia (Province of Aragona), San Giovanello, and Montelonge (Province Casteltermini), and Galleria Ercole (Province Sommatino). According to statistical returns collected in 1865 this system has shown very favourable results.

The first attempts at raising the ore by means of shafts were made at a solfare in the district of Respica (Province Villarosa), and in another on the Colle di Madore (Province of Lercara), by a French mining engineer named De Labretoigne. They were carried on intermittently from 1859 to 1861, but the result was so unsatisfactory that they were given up. In 1865 similar experiments were made at the Solfare of Montedore, but with no better issue; and not until 1868 was the use of shafts seriously taken in hand and successfully carried out. This took place at the Solfare of Grottacalda, at that time under the management of the mining engineer Parodi, from whose report we take this brief extract. Here the shafts proved so advantageous that the same system was soon introduced in the solfares of Floristella, of Gallizzi, and in others of less importance. The new arrangement at Grottacalda cost 78,000 lire; the shaft is 137 metres in depth, and has been in use for raising the ore since 1871.

Since 1872 a steam-engine of 40 horse-power has been working in the great solfara of Sommatino. At the same time shafts were commenced at the solfaras of Raddassa, Montagna (Province Sommatino), and Trabonella in the neighbourhood of Sanatra (Province of Caltanisetta), exclusively destined, however, for the removal of water. In place of the wooden pumps formerly in use metal pumps have been already introduced, which are managed by workmen named *trombatori*.

If we compare the returns of the year 1867 with those of 1871 very notable progress will be perceived. Whilst at the end of 1867, 13 solfaras only employed 20 steam engines, with a collective power of 256 horses, in 1872 21 solfaras are working with 400 horse-power. In the construction of the engines, which are now built on scientific principles, great improvements have been made.

At the mouth of the sulphur mine, each picconiero with the help of his manuali, throws the ore he has raised into a heap (*catasta*), which is then measured by specially appointed officials (*catastieri dell' amministrazione*). As a unity of measurement the *cassa* is employed, a vessel of the form of a parallelepidon which, in different mines holds from 2·5 to 5 cubic metres.

The extraction of the sulphur in Sicily is almost exclusively effected by fusion. The eliquefaction in small cast-iron apparatus (called *doppioni*, because they are fixed in pairs, retort and receiver) as is customary in some solfaras of the Romagna, or in earthen vessels (*pignatti di argilla*), as described in manuals of chemistry, has never been in use in Sicily. As far back as tradition extends very primitive arrangements have been in use in the island, known as *calcarelle*.

For this purpose round holes were dug in the ground of about 2·5 metres in diameter and 4 decimetres in depth, in in the midst of which the *picconieri* piled up the sulphur ores in a high mound—an operation which generally took up two days. This heap was set on fire in the evening, and in the morning of the next day so much liquid sulphur has collected in the outer part of the hole that it can be scooped out and cast into rolls—an operation which lasts till evening, and is resumed on the following day. This process involved little outlay, but the yield was small. Only one-third of the sulphur in the ores was utilized, the remaining two-thirds being diffused in the atmosphere as sulphurous acid, to the annoyance of the inhabitants, and to the serious injury of the adjacent fields.

Since 1850 the eliquation or sulphur in Sicily has been materially improved by the conversion of the *calcarelle* into *calcaroni*. The latter, as the word itself implies, are merely excavations liks those described above, but on a much larger scale, and of an improved construction. They are large round cavities of a semicular or semi-elliptical section, of about 10 metres in diameter and 2·5 metres in depth. They are generally contrived in places where the slope of the ground renders it practicable to arrange a communication from without with the lower part of the calcarone, the bottom of which is made inclining to this point. This external communication, curiously known as *la morte*, consists in an aperture 1·20 metre high and 25 centimetres broad. Within the *calcarone* is lined with a wall of gypsun, from 4 to 5 decimetres in thickness at the back, (*i.e.* the part furthest from the opening), but from 1 to 1·2 metre at the front. The masonry is lined with a smooth layer of gypsum, impenetrable by melted sulphur.

The *calcarone* is charged by workmen known as *riempitori*. The cover, the bottom—which is either the mere ground, or, preferably, a hearth formed of hewn stone—first with a layer of finely ground burnt ore from former operations, (*ginese*) upon which follows a stratum of larger lumps of ore (*tozzi*). Upon this foundation the ore is heaped up, care being taken to put the smaller pieces principally on the outside of the heap. At the same time the outer communication is blocked up with a kind of vault, (*porte*) which is built up with large blocks of the

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

poorest ore about its internal aperture. As soon as the cavity is filled up to the margin the workmen pile up more ore, forming a mound of the shape of a blunted cone, (*colmatura, cucuzzo*) still keeping the larger blocks in the centre, and the smaller about the circumference. By means of the large blocks it is found practicable to leave vertical chimney-like openings in various places, not too far from the margin, and especially at the back of the *calcarone* in order to regulate the draught. The mound is then covered with a stratum of finest powdered ore, (*sterro*) over which follows lastly a coating of ground burnt ore (*ginese*) and known as the *shirt* of the heap (*camicia*). Before igniting the *calcarone* the outward aperture is closed with a thin wall of gypsum, in which small holes are left at various heights, and are closed during the combustion with balls of clay. The heap is kindled by means of bundles of straw dipped in sulphur and thrown into the draught flues. After about an hour all apertures are closed, and the mound is left to itself for eight or nine days. Then mingled vapours of water, sulphur and sulphurous acid begin to make their way through the outer coating of the heap, and around the flues their appears a slight sublimate of sulphur. At the same time the barrier of the outward aperture becomes hotter and hotter near the ground, and finally red hot. By opening one of the holes which had been stoppered with clay, it is possible to aseertain whether a sufficient quantity of melted sulphur—*olio* as the workman call it, has collected at the bottom of the furnace. Now begins the work of the sulphur-casters (*arditori*); with a pointed iron bar (*spiedo*) they perforate the lower part of the gypsum wall, and collect the melted sulphur in moistened moulds of poplar wood (*gavite*) of the shape of a blunted pyramid. In this manner blocks of from 50 to 60 kilos. (*balate*) are obtained, and are sent to market without furtehr preparation. The tapping and casting the sulphur are not everywhere conducted in the same manner. In some works the sulphur is allowed to collect till the end of the entire combustion, and run off at once, but generally the *calcarone* is tapped twice or thrice in the course of 24 hours, so as to remove the sulphur as it collects. The *calcarone* is emptied and prepared for a fresh charge of workman known as *scalcaratori*.

(To be continued.)

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

It has been considered that a slight historical sketch of the rise of the alkali and bleaching-powder manufacture of Glasgow (which indeed was the birthplace of the latter article) would fitly take its place in a report upon the chemical industries of the district, on the occasion of the visit of the Association at this time.

In the search after the necessary data, so many curious facts and figures cropped up, that indulgence must be craved for the length of the communication, which, even as it is, far from exhausts the subject.

Part I.—Salt.

Intimately connected with the manufacture of alkali and bleaching-powder is that of common salt.

The heavy duty on this article at the end of last and beginning of this century retarded for many years the development of the alkali trade.

The following details regarding the salt manufacture are interesting.

In the year 1798 (previous to the rise of duty which came into effect in the summer of that year). the quantity of salt manufactured in Scotland was 350,000 bushels of 56 lbs. each, or 8750 tons, produced by 118 pans distributed as below:—

Division.	Situation.	Pans.
Aberdeen	Patsoy	1
"	Peterhead	2
"	Nigg	2
Ayr	Maryburgh	1
Alloa	Limekilns	1
"	Craigflowers	4
"	Torryburn	1
Anstruther	St. Phillips	7
Borrowstouness	Corly Hall	7
"	Thistone	7
"	Grangepans	5
"	Inverkeithing	4
"	St. David's	4
Irvine	Saltcoats	4
Kircaldy	Kircaldy	2
"	Dysart	7
"	Wemyss	7
"	Methel	8
"	Leven	3
Montrose	Montrose	2
"	Usan	1
Prestonpans	Prestonpans	6
"	Cockenzie	11
"	Cuttle	2
"	Westpans	6
"	Penkie pans	8
"	Duddingstone	4
Stranraer	Gladmock	1
		118

Produced annualy, 350,000 bushels at 56 lbs. each = 8750 tons.

From this it would appear that each pan produced annually about 75 tons, or say 1½ tons per week.

The price was 3s. 3d. per bushel or £6 10s. per ton, duty inclusive, the latter being 1s. 6d. per bushel or £3 per ton.

The additional duty now put on was 6s. 6d. per bushel or £13 per ton, making the cost amount to £19 10s. per ton.

The duty in Scotland was much less than in England, the figures being in the year 1805—Scotland, £12 per ton; England, £30 per ton.

The following is a statement of the method and cost of manufacturing one ton of salt, dated September, 1806:—

"At Mr. Cunningham's works at Saltcoats there are in operation 4 pans, each 18 ft. by 9 ft. by 1 ft. 9 in.; each pan requires three men, or twelve in all.

"These men are paid at the rate of 1s. 1d. per cwt., exclusive of house and fire.

"They keep their fire-places in order without any allowance, repairing them with schistus or clay, got in the immediate neighbourhood. The schistus answers for brick, and they say much better. They are not allowed for the time lost in repairing their boilers.

"The pans are of malleable iron of nearly ⅜ in. thick, supported on malleable iron bars about 3 in. square, placed across under each row of clink nails, say about 15 in. apart.

"A pan, with frequent repairs, lasts about five years, and costs when new about £200.

"These pans yield five castings of salt per week, weighing 10 to 11 cwts. each, agreeable to the strength of the sea water.

"In order to produce these 10 to 11 cwts. of salt, the pan is filled three times till within four inches of the brim (they cannot be filled more with advantage to the ebullition).

"The two first fills are boiled down till the salt begins to form, the first down to within about one inch of the

* Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

bottom, the second to within about one and a half inches, and the last to about two and a quarter inches, which consists chiefly of the pretty dry salt.

"This salt is then raked to the side of the pan, and thrown into a square chest, where it is allowed to drain till a third easting is ready to replace it, two chests being always employed.

"While in this situation it yields about 20 gallons of bittern, or 'pan oil,' as the workmen call it.

"In each pan there are four small round vessels of 8 in. by 4 in., placed one in each corner, which, during the evaporation, collect all the insoluble salts and impurities deposited during the process, sometimes more or less, in proportion, it is said, to the weakness of the water.

"*State of Charges by the ton weight.*

Wages	£1	1	8
Coal dross, 162-192, say 180 cwts., at 1d.	0	15	0
Tear and wear, say..	0	10	0
Rent, say	0	4	0
Cartage of coals, at ¼d. per cwt...	0	3	9
	£2	14	5"

The manufacture of salt is still continued at Saltcoats, but on a different system, the sea water being employed to dissolve rock-salt obtained from Ireland, which gives a solution requiring much less evaporation than the old system.

This method is also carried out to a small extent in Glasgow.

The following table gives the prices of salt for chemical purposes in Glasgow from the year 1798:—

Year.	Price per Ton.
1798	£13 to £18
1800	12 0 0
1801	No details.
1802	"
1803	£12 0 0
1804	12 0 0
1809	19 0 0
1814	11 0 0
1819	1 12 0
1824	2 6 0
1829	1 2 0
1834	0 19 0
1839	1 1 0
1144	0 16 0
1849	0 17 0
1854	0 15 0
1859	0 16 0
1864	0 14 0
1869	0 14 6

At or about which price it has since remained.

The quality of salt used for chemical purposes previous to the introduction of the method of bleaching by chlorine, must of course have been small. Marine acid, however, was made, and there is a tradition amongst the oldest workmen of the chemical works that it was produced (some years previous to the introduction of sulphuric acid about 1749) by the distillation of salt and earthy matter. That this process was actually in use is extremely probable, as it is described by the writers of the last century—eight parts of clay or bolar earth to one of salt being the mixture recommended, distilled in stoneware retorts.

(To be continued).

Supporting Power of Horse-shoe Magnets.—M. V. S. M. van der Weiden.—Free magnetism in a closed and supersaturated magnet is less than for one open and permanent. Free magnetism in the latter state is to the magnetism in the open state about as 3 to 10, a proportion which becomes more and constant as the magnet approaches a definitive permanence.—*Comptes Rendus.*

ON THE DETECTION OF ROSOLIC ACID IN PRESENCE OF MAGENTA.

By MM. P. GUYOT AND R. BIDAUX.

ROSOLIC acid, which dissolves in water with the colour of onion peel, possesses the property of communicating to wines the characteristic shade of old claret. We think it useful to make known at the present time the reactions which serve to detect it, either alone, or in presence of magenta. Some time ago we remarked that magenta is decolourised in presence of ammonia, and that ether removes from the mixture the colouring base, which may be reconstituted by the addition of an acid. In these conditions rosolic acid yields a characteristic rose tint and gives up nothing to ether. If we pour an acid into the rosolic solution, the shade of old claret is destroyed and gives place to a yellowish tint. If heated with gun-cotton, the rosolic liquor is fixed on the nitrogenised fibre, which, well washed and dried, takes a beautiful rose tint in presence of ammonia. This reaction may present itself in the course of the manipulations of an expert instructed to examine wines adulterated with magenta, and therefore it is well to mention it, for, we must call attention to the fact it is the very opposite to what ought to be produced. We easily understand the embarrasment of the expert who, after having obtained gun-cotton or nitrogenised paper slightly coloured, expects to see the colour disappear on contact with ammonia, but perceives, on the contrary, a very vivid rose shade, which, instead of brightening under the influence of acetic acid, becomes yellow. Into a flask containing ammoniacal rosolic acid, we poured sulphuric ether and then strongly agitated the liquid. After the complete separation of the two layers, the ethereal liquid was decanted and poured into another bottle. It was then limpid and colourless; we added to it pure acetic acid, which produced no change; the two layers separated and remained perfectly white. There was therefore no colouration, which shows that, in presence of ammonia, the ether does not remove rosolic acid. The inverse reaction is significant; rosolic acid, having become yellow under the influence of an acid, was treated as above with ether; the upper yellowish layer having been decanted, was submitted to the action of ammonia, which took a rose colour. If, in a flask, we put magenta with acetic acid, the rose tint does not change; ether added to this flask is coloured a violet rose. When decanted and treated with ammonia, there are formed at first two distinct layers, the lower one white and the upper ethereal, containing magenta. An excess of ammonia destroys immediately the colouration, and gives two layers perfectly colourless. It is important to remark that, whilst with magenta the ammonia renders the colouring matter white, with rosolic acid, on the contrary, the same alkali developes a rose shade, *which floats on the colourless ether.* Here, it is the *aqueous liquid* which is coloured, whilst if we acidify ammoniacal ether containing magenta, it is the ether, if in sufficient quantity, which takes the characteristic rose tint. There are then, in these comparative experiments, two very distinct reactions, which can be made use of for the examination of liquids containing the two colouring matters. These reactions are shown in the table.

These reactions being well known, it is easy to separate from a single solution the two colouring matters. We pour into a flask the liquid so be examined; we add ammonia to it; we agitate with ether and then decant. In presence of acetic acid, the ether becomes coloured. This experiment can be checked by means of gun-cotton. In fact, if we saturate this nitrogenous matter with the decanted ether, it is changed into a gelatinous rose-coloured matter, with which we can obtain the reactions of magenta. As for the aqueous liquid, it may serve for a counter-test. The ammonia which it contains is driven off in the water-bath and and we add acetic acid, which communicates the yellow tint mentioned above. If treated then with ether

Gun-cotton	1. Ammonia	Decolouration	Magenta.
		Red colouration	Rosolic acid.
	2. Acetic acid	Red colouration	Magenta.
		Decolouration	Rosolic acid.
Ether and Ammoniacal Solution	1. Ammonia	No action with either of these colouring matters.	
	2. Acetic acid	Red colouration	Magenta.
		No action	Rosolic acid.
Ether and Acetic Solution	1. Ammonia	Ether, at first of a rose colour, becomes decolourised	Magenta.
		Red colouration of the upper layer	Rosolic acid.
	2. Acetic acid	Ether coloured rose	Magenta.
		No action	Rosolic acid.

and ammonia, it is found in the desired conditions to furnish one of the reactions mentioned above. It remains for us to know if, on submitting the mixed liquid to the action of acetic acid and treating with ether, we can separate the two colouring matters. They are both removed by ether, poured into an acetic liquid, which contains then yellow rosolic acid and rose-coloured magenta. When separated from the aqueous liquid, this coloured ether furnishes a very distinct reaction. A few drops of of ammonia decolourise the ether and tinge the lower stratum rose-colour, magenta disappears, and rosolic acid passes into ammoniacal solution. This process, as may be seen, differs very slightly from the former. The original treatment with acetic acid has for its object to render soluble in ether the two colouring matters, and remove them from the water in a more concentrated form. It requires only two manipulations, which, in certain cases of rapid determination is very important—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 28, 1876.

EDWARD SCHUNCK, Ph.D., F.R.S., Vice-President, in the Chair.

" "*Note on a Manganese Ore from New South Wales, and on a Specimen of Native Silver from New Zealand*," by M. M. PATTISON MUIR, F.R.S.E.

I lately received a small specimen of manganese ore taken from a very large deposit near Bathurst, N.S.W. The ore is said to constitute the greater part of a considerable mountain in that neighbourhood.

The sample was greyish black in colour; when broken it exhibited an ill-defined crystalline structure, and showed patches of dark brown or black intermingled with others of dark steel-grey colour.

When heated in a small glass tube a considerable quantity of water was evolved.

The amount of manganese dioxide was determined by the oxalic acid method of Fresenius and Will; the total quantity of manganese was also determined by precipitation with bromine water, after removal of ferric and aluminic oxides; the excess of manganese above that required for the formation of the amount of dioxide found to be present was calculated to protoxide.

The following are the results of the analysis:—

Manganese dioxide	78·72 per cent.
„ protoxide	3·66 „
Ferric and aluminic oxides	6·50 „
Silica	5·80 „
Moisture	4·75 „
	99·43

If the percentage amount of manganese dioxide be calculated on the dried specimen, it is found to amount to 82·21.

Traces of zinc and of sodium were also found.

The specimen of native silver, the analysis of which is appended, was sent to me from the Thames Goldfield, New Zealand. It presented the appearance of arborescent crystals radiating outwards from a central mass at acute angles. A very small quantity of crystalline quartz could be seen in the cavities of the mass.

The silver was estimated by precipitation as chloride; the copper, mercury, &c., were precipitated by means of sulphuretted hydrogen; the copper was separated by solution in nitric acid, and estimated in this solution by the colorimetric method depending upon the use of potassium ferrocyanide, described by Carnelley (*Proc. Manchester Lit. and Phil. Soc.*, 1875-76, p. 24). The iron was precipitated by means of ammonium sulphide, the precipitate was dissolved in dilute hydrochloric acid, and the quantity of iron estimated by Carnelley's colorimetric method (*Proc. Lit. and Phil. Soc.*, vol. v., p. 346).

The sulphide of mercury was dissolved in aqua regia, and an attempt was made to estimate the quantity of the metal by Hannay's volumetric method (*Chem. Soc. Journ.* [2], xi., 565). The quantity present was, however, too small to admit of estimation by this method.

The mercury was approximately estimated by comparing the depth of colour produced in the liquid on the addition of sulphuretted hydrogen water with that produced in an equal bulk of pure water to which a known volume of standardised mercuric chloride solution had been added. This method did not give very satisfactory results; it was found that the shades of colour in the two liquids were not exactly the same. For this reason the quantity of mercury stated below must be regarded as approximative only.

Silica and gangue	1·93
Silver	97·05
Mercury	0·28
	99·26
Copper	0·00005
Iron	0·00109

Very minute traces of bismuth were also detected.

Mr. Muir also exhibited a number of new salts of bismuth, including several chromates, oxybromides, ferrocyanides, &c., likewise specimens of terpenes, &c., from essential oil of sage.

Ordinary Meeting, December 12, 1876.

E. W. BINNEY, F.R.S., F.G.S, President, in the Chair.

Mr. BAXENDELL read the following letter from Mr. JOSEPH SIDEBOTHAM, F.R.A.S., dated Mentone, December 7, 1876:—

There is a little matter I wish you would call attention to at one of the meetings of the Lit. and Phil. Soc., in order that the remarks of the members upon it may be obtained, and if thought desirable, published in the *Proceedings*, so as to come before the public.

My attention has been for some time directed to the growing use of the aniline colours for tinting photographs. Now I find they are being *extensively* used in paintings and water-colour drawings, and the colours regularly sold for that purpose. Any one who knows the speedy alteration by light of nearly all of these colours will protest against their use, and a statement of this with the authority of some of our chemists would probably have the effect of causing them to be discontinued by all artists who care to think that their works should last more than a single year.

Professor C. SCHORLEMMER, F.R.S., exhibited the new colouring matters *fluorescein*, *soluble eosin*, and *insoluble eosin*, as well as samples of silk and wool dyed by them, and showed the characteristic properties of these bodies.

"*On a Mineral Water from Humphrey Head, near Grange-over-Sands, North Lancashire*," by JOSEPH BARNES and HARRY GRIMSHAW, F.C.S.

The mineral spring of which the following analyses have been made issues from the western side of the low promontory of Humphrey Head, almost at the base of the cliffs, and near to the sea shore, but quite above the ordinary high-water mark. The base of the rocks of which the substratum of the head is composed is washed by the tide when high, though it is far away from the water at its ebb in the wide and flat Morecambe Bay, in which the Humphey Head forms the division between the Milnthorpe, or Lancaster Sands, and the Ulverston, or Leven Sands. The north and east sides of the head descend in a gentle slope to the sands, whereas the west and south sides present a rugged and perpendicular face of limestone rock.

As regards the geology of the Head; the strata of which it is composed, consist of mountain limestone, based upon the upper Silurian, which structure, we learned from Professor Dawkins, is common to a great portion of that district. Humphrey Head, therefore, seems to form a small outlying spur of the mountain system of the district, but it is completely separated by a strip of low-lying land from the nearest connected spur of the high lands of the neighbourhood, which is Kirk Head and contains the well-known cave in which such interesting antiquarian discoveries have been made. The whole of this neighbourhood is remarkable for the general absence of streams or springs of any description, owing doubtless to the very porous nature of its rock formations, which allow the water to percolate down to the sea-level instead of finding their way along the surface to any extent.

The mineral spring which issues as described near the base of the Humphey Head, was formerly and we suppose is still known by the name of the Holy Well. Two samples of its water have been taken, the first (*a*) on August 29th, 1875, and the second (*b*) on the 20th of the same month, 1876. The following data were obtained on analysis:—

Sample (*a*) had an almost imperceptible alkaline reaction.

1.) Specific gravity—bottle holds 25·031 grms. water.
" " " 25·176 " mineral water.
Specific Gravity—1·00579 at 15° C.

(2.) Ammonia—half a litre distilled by Wanklyn's process gave 0·47 grm. free ammonia and 0·03 of alluminoid ammonia, equal to 0·94 and 0·06 pts. per million respectively.

(3.) Chlorine—10 c.c. of the water required 33·1 c.c. standard nitrate of silver (1 c.c. = 1 m.grm. Cl).

(4.) Total solid matter—100 c.c. on evaporation gave 0·729 grm., which on analysis gave—

(5.) Silica—0·0006 grm.
(6.) $BaSO_4$—0·294 containing 0·1008 SO_3.
(7.) $CaCO_3$—0·1088 " 0·0608 CaO.
(8.) $Mg_2P_2O_7$—0·08 " 0·0288 MgO.
(9.) Traces of iron and alumina were found.

Sample (*b*) had a neutral reaction.

(1.) Total solid matter—as a mean of three determinations 100 c.c. gave 0·7352 grm.

(2.) Chlorine—as a mean of two determinations 5 c.c. took 16·65 c.c., standard $AgNO_3$.

(3.) Hardness—10 c.c. were made up to 250 c.c., and 70 c.c. gave 4·1° of hardness.

(4.) Iron and alumina—traces were found.

Sample (*a*).	Grs. per Gal.	Sample (*b*). Grs. per Gal.
Silica (SiO_2)	0·42	—
Sulphuric acid (SO_3)	70·50	—
Lime (CaO)	42·50	—
Magnesia (MgO)	4·89	—
Magnesium (Mg)	9·37	—
Chlorine (Cl)	231·70	233·10
Alkalis (K and Na)	150·92	—
Total solids	510·30	514·64
Hardness	—	102·50

A calculation of these results on the usual assumptions of the combination of the different bases and acids, yields the following result for sample (*a*), leaving the small amounts of silica and ammonia out of consideration.

	Grms. per Gal.
Silica	0·42
Calcium sulphate	103·21
Magnesium sulphate	14·68
Magnesium chloride	37·07
Sodium chloride	270·03
Potassium chloride	84·90
	510·31

The lime is placed as in combination with sulphuric acid, as forming the most insoluble compound with it, and that a considerable amount of the magnesium is combined with chlorine is evident from the fact, that an estimation of chlorine in the solid residue, after heating it for some time to 170° C. gave only 219·8 grs. of Cl per gallon, showing a loss of 11·9 grs. The relative amounts of potassium and sodium chlorides are calculated by difference, from the total alkali and chlorine.

Remarks on Results of Analysis.—The proportion between the free and alluminoid ammonia, in this water is very remarkable, the amount of the former being conspicuously large (0·94 pts. per mil.), whereas the latter is hardly more than detectable (0·06). The amounts of alkaline chlorides (354·93 grms. per gal.) is very large, mostly consisting as will be seen of chloride of sodium. We are of opinion that this is due to the upward absorption of a certain amount of sea water by the porous rocks through which the waters of the spring find their way; in fact, the whole contents of the water seem to be only such as might be naturally expected from the nature of the rock construction of the Humphrey Head and its proximity to the sea. It is stated in works referring to this district that this sping was at one time in high repute for the medical qualities of its water, more especially in the cure of various cutaneous disorders, but at the present time it is seldom visited except from curiosity, though a few of the country people around seem to have a lingering belief in its virtues.

For some of the figures in the above analyses we owe our thanks to Mr. Chaster, late a student of the Owens College.

Since the above was written, our attention has been directed to an analysis of the water of this spring, published in the year 1868 in the *Journal of the Chemical Society* (2nd Series, VI., 20), by T. E. Thorpe (now F.R.S.), in which the author gives more minute details of the constituents of the water, than we have done in this paper, but which in the main shows that the quality of the water remains very constant. The exception to this is in the

amount of potash, which in our case (calculated from the amounts of acid and base) is very much larger than in Thorpe's analysis. We hope at a later date to perform other and more minute analyses of this spring, in order to see as far as possible whether this uniformity is still maintained.

ACADEMIE DE ST. PETERSBURG.

D. Paulow, "*Action of Monochlorinated Acids upon Zinc Hydrocarbons.*" The author has presented, in a somewhat bulky article, a valuable addition to the literature of the tertiary alcohols and ketones. He records the results of a large number of experiments upon the formation of aceton and trimethyl carbinol by the action of acetyl chloride on zinc methyl in varied proportions, giving the quantitative results. A new tertiary heptyl alcohol, $C_7H_{16}O$, was obtained by treatment of butyryl chloride, first with zinc methyl and subsequently with zinc ethyl. This new compound, *methyl-ethyl propyl carbinol*, is the first tertiary alcohol containing three different hydrocarbons united with the same carbon atom, and forms a colourless liquid with the odour of camphor. The corresponding hydrocarbon, C_7H_{16}, an oily liquid boiling at 90° to 95°, is obtained from the iodine compound. *Methyl-ethyl isopropyl carbinol* is obtained in the same manner from isobutyryl chloride, and yields a hydrocarbon boiling at 75° to 80°. A series of experiments on the action of zinc methyl and zinc ethyl with aceton show that it possesses invariably a dehydrating character, and is always accompanied by the formation of condensation products, especially of mesityl oxide. The author has also obtained three compounds analogous to mesityloxide from the action of zinc methyl upon acid chlorides: $C_8H_{14}O$, from propionyl chloride; $C_{10}H_{18}O$, from isobutyryl chloride; and $C_{12}H_{22}O$, from valeryl chloride. These are all colourless liquids, boiling at high temperatures, with strong aromatic odours, and do not yield corresponding hydrocarbons.

WIENER AKADEMIE DER WISSENSCHAFTEN.

K. Zulkowsky, "*Action of Glycerin upon Starch at High Temperature.*" A mixture of 50 grms. of potato or wheat starch with 1 kilogramme of concentrated glycerin, exposed to a gradually rising temperature under continual stirring, exhibits the following changes:—The granules gradually swell, and at 130° a pasty mass is formed. The consistency then decreases continually, and at 160° to 170° the starch is completely dissolved, forming a yellow transparent solution. At 190° the starch is almost entirely changed into the so-called soluble modification, which is separated out from the cold solution by dilution with water and addition of alcohol. This modification is easily soluble in water, and retains this property as long as it is preserved in a moist condition with alcohol, but loses it by drying. The aqueous solution gives the usual colouration with iodine, and turns the plane of polarisation very strongly to the right. Lime water and baryta water cause precipitation from the aqueous solution.

F. Odstreil, "*Experiments on the Magnetic Action of Rotatory Conductors.*" From a large number of observations of the magnetic effects caused by a rotating sphere of zinc upon magnets in the vicinity, the author finds that considerable deviations are caused as long as the axis of the sphere does not lie in the direction of the terrestrial magnetism. The law regulating the distribution of magnetic force according to the inclination of the axis has been fully defined. As these induced currents in a rotatory sphere are due to terrestrial magnetism, the opinion of the author is strengthened that the periodically recurring deviations of the needle are possibly due to solar and lunar magnetism.

L. Barth and C. Senhofer, "*Action of Fuming Sulphuric Acid on Sulphobenzolic Acid, and a new Disulphobenzolic Acid.*" Equal volumes of fuming sulphuric acid and sulpho-benzolic acid, heated in a retort, yield meta-disulpho-benzolic acid, $C_6H_4(SHO_3)_2$, which is easily obtained pure by the usual treatment with carbonate of lead and sulphuretted hydrogen. It crystallises easily, is exceedingly deliquescent, and forms crystalline salts. The potassium salt treated with potassium cyanide yields meta-dicyan-benzol (M. Pt. 160°), which by treatment with potassium hydrate is changed into isophthalic acid. Both para- and meta-disulpho-benzolic acids yield resorcine by melting with potassium hydrate, another proof that this process is not always reliable in determining constitutional formulæ.

O. Rembold, "*Derivatives of Ellagic Acid.*" Ellagic acid heated with zinc dust in hydrogen yields two bodies, one red and the other colourless. The latter has been examined, and receives the name ellagine. It is isomeric with anthracen, phenanthren, and tolone, $C_{14}H_{10}$, but does not yield a quinon and picrate, or form a fluorescent solution in benzol, as its isomers. Reduction with sodium amalgam gives likewise two bodies. The first, *rufo-hydro-ellagic acid*, $C_{14}H_8O_6$, melts at 300°, is easily oxidised, forms no salts, and gives with ferric chloride a wine-red colouration. The second, $C_{14}H_{10}O_7$, is identical with a derivative of gallic acid previously obtained by the author, and now receives the name of *glauco-hydro-ellagic acid.*

F. Schardinger, "*Nitro-Derivatives of Anthraflavon.*" Anthraflavon added to 40 times its weight of nitric acid causes, upon heating, a violent reaction. On cooling, yellow crystals of tetra-nitro-anthraflavon, $C_{12}H_4(NO_2)_4O_4$, separate out. Chrysophanic acid is the only isomer of anthraflavon forming a corresponding body. This nitro compound forms an exceedingly sensitive test for the presence of ammonia, the slightest trace of the latter causing the appearance of an intense red colour. Three distinct compounds are formed with ammonia—

$$C_{14}H_2(NO_2)_4(NH_4)_2O_4,\ C_{14}H_2(NO_2)_4(NH_4)_2O_4+NH_3,$$
$$\text{and } C_{14}H_2(NO_2)_4(NH_4)_2O_4+2NH_3.$$

In the filtrate from the crystals of tetranitro anthraflavon a *trinitro-oxy-benzoic* acid, $C_7H_3(NO_2)_3O_3$, was found, which was also obtained from the first body by boiling for a long time with nitric acid. It forms crystalline salts, and gives a red colouration with ferric chloride.

C. Senhofer, "*A New Derivative of Naphthalin.*" A solution of naphthalin in sulphuric acid mingled with phosphoric anhydride, and heated in a closed tube for several hours at 260°, yields naphthalin-tetrasulphonic acid, $C_{10}H_4(SO_3H)_4$, the most highly substituted sulphonic acid in this group. The reaction could be used to advantage in many other groups.

L. Barth, "*Tetra-methyl-ammonium-ferrocyanide.*" This compound, $[FeCy_2+[(CH_3)_4NCy]_4+13H_2O$, is easily obtained by neutralising an aqueous solution of tetra-methyl-ammonium-hydrate with ferrocyanic acid. Yellow, hexagonal laminæ, decomposed at 140°.

L. Boltzmann, "*Heat Equilibrium of Gases under the Influence of External Forces.*" A lengthy physico-mathematical article, in which the author seeks to prove that his law of probabilities and that of Maxwell, with regard to the positions, rapidity of motion, and direction of motion of gaseous molecules, when restoring the condition of heat-equilibrium, is also applicable in the case of exposure to the action of external forces, as well as in their absence.

L. Boltzmann, "*Convection of Heat in Gases.*" The author finds that Maxwell's constants for the theoretical determination of the convection of heat in gases are far too high when compared with the results obtained from Stefan's careful observations. From theoretical considerations he assigns $\frac{1}{15}$ as the general constant for the various gases, representing the portion of the convection of heat due to the intramolecular movement. The results obtained with this constant coincide very closely with Stefan's observations.

L. BOLTZMANN, "*Integration of Partial Differential Equations of the First Order.*"

H. WEISEL, "*On Cinchonine.*" The author has previously described four new acids obtained from cinchonine by oxidation with nitric acid. Among the products of the reaction he has also discovered a fifth body, exceedingly soluble in water, and entering into combination with both acids and bases—$C_{16}H_{18}N_2O_5$. The oxidation products of cinchonidine are found to be exactly the same as those derived from its isomer cinchonine.

H. DUREGE, "*Double Tangents of Curves of the Fourth Order.*"

R. MALY, "*Action of Bromine on Bilirubin*" Upon mixing together solutions of both of these bodies in chloroform, a brilliant blue colour appears, and upon the addition of water, a greenish blue powder, tri-bromo-bilirubin, $C_{32}H_{33}Br_3N_4O_6$, is precipated. The new compound has also been prepared synthetically, and the results incline the author to double the present formula for bilirubin. The alcoholic solution examined with the spectroscope allows only green and blue light to pass through; upon the addition of zinc chloride and ammonia, a narrow, dark, well-defined line is perceived at 105 to 111, that is between the sodium and lithium lines. Tri-bromo-bilirubin is insoluble in water, soluble in alcohol and other strong solvents, crystallises in small black prisms, is changed by reducing substances to hydro-bilirubin, and by alkalies to biliverdin.

J. TOLLINGER, "*Thermal Phenomena attending the solution of Ammonium-nitrate in Water, and their Application in Freezing Mixtures.*" A lengthy article, giving the results of an extensive series of experiments, with regard to the determination of—(1) The specific heat of the solutions; (2) the heat required for solution at various temperatures; (3) the influence of the water used; (4) the lowering of the freezing-point; (5) the solubility of the salt. The conclusions arrived at, are that this solution is especially valuable when the temperature at the commencement is above 0°, and that the greatest economy is obtained by using a solution of such a degree of concentration that it will be exactly saturated when the desired temperature is attained.

S. L. SCHENCK, "*The Green Colouring Principle of Bonellia Viridis.*" Gottlieb has shown that the chemical properties of this coloring matter coincide with those of chlorophyll. The author finds the absorption spectrum given by an alcoholic solution somewhat different from that afforded by chlorophyll under the same conditions. The substance after having been preserved for twenty-five years, gives a different absorption spectrum from that afforded by it when freshly prepared, and coincides with the spectrum of the latter upon the addition of an organic acid to the solution.

J. OSER and G. FLÖGL, "*A New Condensation Product from Gallic Acid.*" Oxidation of gallic acid yields a new acid, hydrorufi-gallic acid, $C_{14}H_{10}O_8$, which is tolerably insoluble in water, but in other solvents gives rise to a variety of colour reactions.

NOTICES OF BOOKS.

The Faraday Lecture for 1875. The Life-Work of Liebig in Experimental and Philosophic Chemistry, with allusions to his Influence on the Development of the Collateral Sciences and of the Useful Arts. A Discourse. By A. W. HOFMANN, F.R.S., V.P.C.S. London: Macmillan and Co.

IT would be a mere waste of time on our part were we to attempt an abstract of the magnificent eulogium paid by Dr. Hofmann to the memory of his great master. It speaks for itself and renders all comment superfluous. But there are ideas put forth in this volume which have a wider interest even than the fame of the two great men with whom the discourse is more especially connected. It is often asked how ought science to be taught and what manner of men should be the teachers? In this country, at the present day—and more, we fear, than in times bye-gone—the whole duty of the teacher is summed up in "preparing" pupils for examinations. Students "read" instead of working for degrees and honours. Universities are regarded not as places for original research, but for cram. Now to us it seems that the question, How is chemistry to be taught?—and for every science the essential principle is the same—may best be answered by another, "How did Liebig teach?" For in addition to all his other merits he was the great type of the science teacher. The answer is ably and most truthfully given by Dr. Hofmann:—We felt then, we feel still, and never while we live, shall we forget Liebig's marvellous influence over us; and if anything could be more astonishing than the amount of work he did with his own hands it was probably the mountain of chemical toil he got us to go through. I am sure that he loved us in return. Each word of his carried instruction, every intonation of his voice bespoke regard; his approval was a mark of honour, and of whatever else he might be proud, our greatest pride of all was in having him for our master It was our delight, too, to know that we helped him that whilst we received his lessons we were also performing his work. The aid he thus obtained he was too just ever to deny or underrate; nay, his generosity often attributed te a pupil the whole credit of a successful experiment suggested by himself on the basis of previous trials and discoveries of his own, and of his deductions therefrom. Of our young winnings in the noble ground of philosophical honour, more than half were free gifts to us from Liebig; and to his generous nature no triumphs of his own brought more sincere delight than that which he took in seeing his pupils' success, and in assisting while he watched their upward struggle."

We should recommend every science-teacher to ask himself seriously, how nearly he is approaching, or endeavouring to approach, to this ideal? Is he training up investigators and filling their minds with an ardent love of truth for its own sake? If not—if he is either unwilling or unable to tread, though at a great distance, in the footsteps of Liebig—let him doubt whether he is "the right man in the right place." Some teachers may perhaps plead that they are the victims of a bad system—that their pupils are expected not so much to "know" as to "pass"—and that their reputation and efficiency are measured by such passing. If so, let them join in with those who are waging war against this miserable system. The only examination for a man of science is to prove, *rebus gestis*, that he can work.

The oration has also its lessons for the student. Liebig, we are told, was "ever anxious to retain the safe guidance of experiment. A happy speculator himself, he never fails to curb the evolutions of nis imagination by the bridle of sober observation. If he finds his speculation to be in contradiction with recognised facts, he endeavours to set these facts aside by new experiments, and failing to do so he drops the speculation." He never forgot the lesson which he received in his early career when an ingenious theory cost him the discovery of bromine. Speaking of himself in the third person, he says:—"I know a chemist who, while at Kreuznach, many years ago, undertook an investigation of the mother-liquor from the salt works. He found iodine in it; he observed, moreover, that the iodide of starch turned of a fiery yellow by standing over night. The phenomenon struck him; he procured a large quantity of the mother-liquor, saturated it with chlorine, and obtained by distillation a considerable amount of a liquid colouring starch yellow, and possessing the external properties of chloride of iodine, but differing in many of its reactions from the latter compound. He explained, however, every discrepancy most satisfactorily to himself; he contrived for himself a theory

on it (*er machte sich eine Theorie darüber*). Several months later he received the splendid paper of M. Balard, and on the very same day he was in a condition to publish a series of experiments on the behaviour of bromine with iron, platinum, and carbon, for Balard's bromine stood in his laboratory labelled *liquid chloride of iodine*. Since that time he makes no more theories unless they are supported by unequivocal experiments, and I can positively assert that he has not fared badly by so doing."

But Liebig's career affords a further lesson, which lies, so to speak, in the same direction, and which, though not referred to in the book before us, should not be overlooked. Liebig tells us that in one part of his early life he was seduced into those metaphysical studies which were then so popular in his country. For a time this pursuit seemed to him alike pleasant and profitable. But he suddenly awoke as from a dream, and found that two precious years of his life had been wasted without any benefit to himself and to science. At a time when metaphysical learning is again raising its head, and seeking to escape from the accusations of unprogressiveness and sterility—when it is even alleged as a reproach against eminent men of science that they are ignorant of metaphysics—this confession coming from a source so unimpeachable is of the highest value, and may prevent many from being misled.

CORRESPONDENCE.

ANTHRACEN TEST.

To the Editor of the Chemical News.

SIR,—In reference to the new test for anthracen published in the CHEMICAL NEWS (vol. xxxiv., p. 278) I think it is but right to say that the test in question was worked out by me, in the spring of 1876, at the request of the Badische Anilin and Soda Fabrik, of Ludwigshafen, and that no one has been authorised to publish it, as for the present, for various reasons into which I need not enter, it has not been considered desirable to do so.—I am, &c.,

FREDERICK A. MANNING.

BUTTER ANALYSIS.

To the Editor of the Chemical News.

SIR,—I wish to supplement with a few remarks my short paper upon Butter Analysis which appeared in the CHEMICAL NEWS of December 15.

Those who have not got a balance of the kind described can readily apply the specific gravity beads instead of it, at any rate as indicators of the purity or otherwise of the butter under examination. All that is necessary is a large beaker kept full of water boiling, and supported in it the tubes full of the fat to be examined.

Three beads, one of which would float just under the surface of pure butter fat, one just under the surface of a 50 per cent. mixture, and one under the surface of beef fat (all tested at boiling heat of water), would at once give an approximate idea of the amount of adulteration the sample in which they were tried. I then advise, as the best practical method of estimating fairly the percentage of adulteration, that after the gravity has been obtained, the fatty acid determination be made. I invariably follow out this method when dealing with a case which may result in prosecution. I must apologise for the apparently imperfect description of my little apparatus in the CHEMICAL NEWS of December 15, but it was intended that a cut of the whole should accompany it, which, however, was at the last moment unavoidably omitted.

C. ESTCOURT.

8, St. James's Square, Manchester.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 22, November 27, 1876.

Crystals of Magnetic Oxide of Iron Formed during the Roasting of Spathic Minerals.—M. Boussingault.—The crystals in question are ferrous oxide found in a chink of the wall of a roasting-furnace, where the ore treated is a spathic iron containing, besides the quartzose gangue, carbonates of manganese and lime, and from 45 to 55 per cent of protoxide of iron. The crystals are regular octahedra, magnetic without possessing polarity, and yield a black powder. In composition they approach closely to the natural magnetic oxide of iron.

Composition of Gun-Cotton.—Prof. F. A. Abel.—A reply to the paper of MM. Champion and Pellet (*Comptes Rendus*, lxxxiii., p. 707). Prof. Abel points out that he has never pronounced the gun-cotton of commerce to be trinitro-cellulose, as it generally contains a certain proportion of lower nitro compounds, of raw cellulose, of products furnished by the action of the acids upon the fatty or resinous matters enclosed in the fibre of cotton, and, lastly, of mineral bodies. The analysis of compressed gun-cotton can be effected by the ordinary combustion process.

New Electric Repulsion, and on its Application to the Theory of Comets.—E. Reitlinger and A. d'Urbanitzky.—If we approach the finger or any conductor to the luminous column produced in a Geissler tube we observe an attraction, which has been explained by the known laws of the electric influence. But on the 9th of March of this year we met with tubes in which the experiment, thus conducted, manifested, not an attraction, but a very distinct repulsion. These exceptional tubes have contained, according to M. Geissler, the one bromine and the other protochloride of tin. In addition to the repulsion there was observed in the tubes a green light, of a singular aspect, on the side towards which the luminous column was directed. Our researches showed us that this green light was due to a kind of electric phosphorescence, which we have described in the *Memoirs of the Academy of Vienna*. A spectroscopic examination did not reveal any distinction between the bromine tube and that which had contained protochloride of tin. In both cases the most distinct portions of the spectrum displayed those three well-known bands commonly attributed to the spectrum of carbon. They are the same bands which M. Vogel and others have designated as the spectrum of comets. This remarkable fact has drawn our attention to the relations between this repulsion and the repulsion exerted upon the tail of comets by the sun. The identity of the spectra may be explained by supposing that the gas introduced into the Geissler tubes no longer gives any light; that it is either absorbed by the electrodes or precipitated upon the glass; and that a trace of highly rarefied gas furnishes the luminous matter, the repulsive power of which has been observed.

Researches on the Vitality of the Ova of the Phylloxera.—M. Balbiani.—The ova have been exposed to the action of alkaline sulpho-carbonates, of bisulphide of carbon, of bichromate of potassa, and of empyreumatic bodies.

Treatment of Phylloxerised Vines.—M. B. Boiteau.—An examination of various measures, prophylactic and remedial.

Explanation of "Actio in Distans," Gravitation and Electric Action.—M. A. Picart.—All the phenomena of the universe may be explained by matter and motion *alone* without *forces acting at a distance*. For this pur-

pose it is sufficient to imagine infinite space filled with eternal matter consisting of a mass of atoms animated by a perpetual movement in all directions. This matter, the sub-stratum of the world, is what is commonly called *ether*. Only it has been hitherto regarded as a fluid whose molecules have in a state of equilibrium, fixed relative positions, each exerting upon the neighbouring molecules a repulsive action which give rise to vibratory movements whenever this equilibrium is disturbed by any cause whatsoever. According to the new theory of gaseous fluids (Clausius) we may henceforth conceive the ether as formed of *elastic* atoms moving with considerable speed in all directions, and producing at each point by their impacts upon an ideal elemental plane a determined pressure. From this new conception of the ether, which in nowise contradicts the ancient view, and which even includes it as a corollary (*Theorie mécanique de la chaleur*, de M. Briot) gravitation at once follows, *i.e.*, the mutual attraction of two material points in the ratio of their masses, and inversely as the square of their distance. As to electric actions they may be explained in an analogous manner. The material molecules in arranging themselves by their mutual attractions so as to form bodies must condense around themselves the ethereal atoms as atmospheres more or less dense, the elasticity of which must vary according to the relative positions of the molecules of the body. These are the atmospheres whose increases or diminutions of density or of elastic force constitute the electric condition —positive or negative—of the body. Between these atmospheres and the material molecules situate at a distance there must be exerted a gravitation like that of two material molecules. Between two condensed atmospheres of ether a repulsive action must be exerted, resulting from the necessary increase of the speed of the atoms which move in both directions from the one atmosphere to the other, and which produce upon each of them, on the side where they strike, an augmentation of pressure tending to remove them from each other. From these reactions we easily arrive at Coloumb's law of attraction or repulsion, the basis of all electrical theory.

Crystals of Gallium.—M. Lecoq de Boisbaudran.—The author has presented to the Academy crystals of metallic gallium. The values found for the angles appear to lead to a clino-rhombic form.

Determination of Sugars by means of Normal Solutions.—M. E. Perrot.—The author prepares a standard solution of copper by dissolving 39·275 grms. of sulphate of copper, very pure, and dried between several folds of filter-paper, and makes it up with distilled water to 1000 c.c. Each c.c. of this solution contains 0·01 of copper. On the other hand, he dissolves about 25 grms. of pure cyanide of potassium in 1 litre of distilled water. Of this solution 10 c.c. are taken and put in a flask, to which about 20 c.c. of ammonia are added, and the liquid is kept at a temperature of 60° to 70°. He pours in the copper solution drop by drop by means of a burette graduated into tenths of a c.c., until there appears the blue tint characteristic of salts of copper in an ammoniacal solution. The number of degrees of the burette are then read off, and indicate the quantity of copper which has been required to produce the reaction. The solution of the sugar in question (previously inverted if it is required to determine crystalline sugar) is then placed in contact with an excess of Fehling's liquor, and reduced in the water-bath. The whole is filtered in order to collect the precipitate of suboxide, which is first well washed with hot water, and dissolved in nitric acid, diluted with an equal volume of water, and a few fragments of chlorate of potassa are added. This solution is effected on the filter, which is then carefully washed in acidulated water. The filtrate, to which the washings are added, is then mixed with water enough to make up 100 or 150 c.c., and is then poured by means of the burette into 10 c.c. of cyanide, mixed with 20 c.c of ammonia as above, stopping when the blue colour appears, and reading off the quantity of copper employed. From the former experiment it is known how much copper 10 c.c. of the cyanide solution require. Hence it is easy to calculate the total amount of copper which has been present as suboxide. The amount of sugar is then found from the data that 9298 parts of copper equal 5000 of crystalline sugar, or 5263 of glucose.

Second Note on the Detection of Magenta in Wines.—M. Fordos.—(*First Method.*) 10 c.c. of wine are mixed with 1 c.c. of ammonia and 10 c.c. of chloroform, mixing the liquids by repeated inversions of the tube, but without shaking. The chloroform is separated by means of a funnel with a tap, and collected in a test-tube. A little water is added, so that there may be about 1 c.c. above the chloroform, and an excess of acetic acid is poured in. The magenta, re-formed, separates from the chloroform, and floats above it as an aqueous solution more or less strongly coloured. This experiment may be performed in three minutes, and shows the presence of magenta in wines down to about 1 m.grm. per litre. (*Second Method.*) Wine and ammonia as above are mixed merely with 5 c.c. of chloroform. When the latter has collected in the bottom of the tube a crystal of citric acid, weighing 2 to 3 grms., is dropped into it. The acid saturates the ammonia and reproduces the magenta, which is deposited upon the crystal with its well known and beautiful colour.

Gazzetta Chimica Italiana.
Anno vi., 1876, Fasc. vii. and viii.

On Certain Derivatives of Santonic Acid.—Prof. S. Cannizzaro.—The substances examined by the author are hydrosantonic acid and its salts, acetyl-hydrosantonide, benzol-hydrosantonide, hydrosantonamide, and metasantonic acid.

On the Crystalline Form of Certain Derivatives of Santonin.—Giovanni Struver.—This paper consists chiefly of tables of angles calculated and observed, and is accompanied by two diagrams.

On Methylic Santonate.—S. Cannizzaro.—A white crystalline substance, which melts at 86° to 86·5°, and may be represented by the formula $C_{15}H_{19}CH_3O_4$.

On Photosantonic Acid.—Fausto Sestini.—This acid is obtained either by the saponification of its ethers, obtained by the action of sun-light upon a solution of santonin in ethylic or methylic alcohol, or much more readily by means of solar action upon a solution of sontonin in dilute acetic acid. The author describes both these methods, and examines the salts of the acid.

On Asparagin and Aspartic Acid.—Icilio Guareschi.—An examination of the action of urea upon asparagin, of aspartic acid and urea, of the halogens upon asparagin, as also of nascent hydrogen, phenol, and glycerin.

On the Determination of Nitrogen in Milk and in its Products.—G. Musso.—The author urges that the method of Will and Varrentrapp should be more carefully examined, and if its inaccuracies are proved, that it should either be modified or definitely abandoned.

Action of Hydrate of Soda upon the Amylic Alcohol of Slow Fermentation.—Luigi Balbiano.—The author finds that amylic alcohol, lævorotatory or inactive, distilled with excess of caustic soda, does not become dextro-rotatory, but the lævorotatory becomes inactive.

On the Preparation of Nitrate of Ethyl.—Giacomo Bertoni.—Nitrate of ethyl is prepared, according to the author's method, by the reaction of urea and nitric acid upon alcohol at 92 per cent.

Observations on Prof. Brugnatelli's Paper on the Alkaloid of Spoiled Maize.—Prof. Cesare Lombroso.—The poisonous principle of mouldy maize, when introduced into the tissues of a frog, brought on tetanic convulsions.

Chemico-Hygienic Examination of the Water of Marcia, at Rome.—C. Carlucci, B. Balestra, and F. Sestini.—Not suitable for abstraction.

On the Thermo-Electric Property of Sodium and Potassium.—A. Maccari and M. Bellati.—A lengthy paper, not fitted for useful abstraction.

Jahrbuch der K.K. Geologischen Reichsanstalt, Vienna. Vol. xxvi., 3.

Properties of Ferric Oxide at High Temperatures.—W. Suida.—As the results of an extensive series of experiments, which are described in detail, the author reaches the following conclusions:—1. Ferric oxide is not changed in the slightest at the highest temperature of a Bunsen burner, provided no reducing bodies are present. 2. Ferric oxide, alone or in silicates, is partially changed to ferrous oxide if the temperature is raised to a bright red heat or to the beginning of a white heat, also if the process is performed in an atmosphere of nitrogen. 3. The same change takes place by the fusion of ferric oxide, alone or in silicates, with borax or glass, also if the operation is carried on in nitrogen or carbonic acid gas. 4. Fusion of ferric oxide with borax in an atmosphere of oxygen causes the formation of but an exceedingly small quantity of ferrous oxide. 5. Hermann's method of determining the amount of ferrous oxide in a silicate by fusion with borax is not reliable, the results often being three times greater than the reality. 6. The most satisfactory decomposition of a silicate, with a view of determining the quantity of ferrous oxide is accomplished by heating in a sealed tube of Bohemian glass with a mixture of hydrofluoric acid and dilute sulphuric acid.

Repertorium fur Experimental Physik, von Dr. Ph. Carl. xii. Band., Heft. 5.

This issue contains papers on the "Tension Curve of Saturated Water," by Dr. Oscar Fabian; the Universal Lever," by K. Tschechowitsch; on the "Diffusion of Gases through Absorbent Substances," by Dr. S. von Wroblewski; "Apparatus for the Determination of the Specific Gravity of Gases, especially Coal Gas," by Prof. A. Wagner; "Indicator for Watercourses," by Dr. Hasler; "Monthly Averages of the Magnetic Declination and Horizontal Intensity, as taken in the Prague Observatory in 1875;" "Daily Variations in the Horizontal Intensity of Terrestrial Magnetism at Prague in 1867-1875;" "Dependence of the Co-efficients of Internal Friction of Gases upon Temperature," by A. V. Obermayer; "On the Magnetism of Soft Iron Cylinders, with an Appendix on the Magnetism of Various Hard Steels," by Dr. Chr. Ruths.

None of the papers are capable of useful abstraction, and all the more important require illustrations.

MEETINGS FOR THE WEEK.

Monday, Jan 8th.—London Institution, 5.
—— Medical, 8.
—— Royal Geographical, 8.30.
Tuesday, 9th.—Photographic, 8
—— Anthropological Institution, 8
—— Royal Institution, 3. Prof. Gladstone on the "Chemistry of Fire.
Wednesday, 10th.—Geological, 8.
Thursday, 11th.—Royal, 8.30.
Friday, 12th.—Astronomical, 8
—— Quekett Club, 8.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

November, 1876.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride Sulphuric.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Thames Water Companies.												
Grand Junction	Clear	0·000	0·007	0·120	0·048	20·31	8·231	0·432	1·01	1·412	14·3	4·2
West Middlesex	Clear	0·001	0·006	0·165	0·048	19·84	8·624	0·468	0·94	1·534	14·3	3·3
Southwark and Vauxhall	Slightly turbid	0·001	0·008	0·120	0·058	20·42	8·512	0·468	0·94	1·271	14·8	3·7
Chelsea	Slightly turbid	0·000	0·006	0·168	0·039	20·80	8·680	0·576	1·01	1·071	14·3	2·8
Lambeth	Slightly turbid	0·001	0·005	0·180	0·038	20·60	9·016	0·468	1·01	1·411	14·8	4·2
Other Companies.												
Kent	Clear	0·000	0·002	0·300	0·014	26·12	10·640	0·684	1·37	2·869	18·8	5·1
New River	Clear	0·001	0·004	0·165	0·014	19·31	8·680	0·396	0·87	1·281	14·8	2·0
East London	Clear	0·000	0·004	0·120	0·034	22·01	8·960	0·612	1·08	1·611	15·9	3·3

The quantities of the several constituents are stated in grains per imperial gallon of 70,000 grains.

Note.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. Meymott Tidy.

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THE CHEMICAL NEWS.

Vol. XXXV. No. 894.

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, Ph.D.,
Professor in University College, Toronto.

I. *On the Reactions of Metallic Thallium before the Blowpipe.*

The following reactions are given from direct experiments by the writer:†—

In the closed tube thallium melts easily, and a brownish red vitreous slag, which becomes pale yellow on cooling, forms around the fused globule.

In the open tube fusion also takes place on the first application of the flame, whilst the glass becomes strongly attacked by the formation of a vitreous slag, as in the closed tube. Only a small amount of sublimate is produced: this is of a greyish white colour, but under the magnifying glass it shows in places a faint iridescence.

On charcoal, *per se*, thallium melts very easily, and volatilises in dense fumes of a white colour, streaked with brown; whilst it imparts at the same time a vivid emerald-green colouration to the point and edge of the flame. If the heat be discontinued the fused globule continues to give off copious fumes, but this action ceases, at once, if the globule be removed from the charcoal. A deposit, partly white and partly dark red, of oxide and teroxide is formed on the support; but, compared with the copious fumes evolved from the metal, this deposit is by no means abundant, as it volatilises at once where it comes in contact with the glowing charcoal. If touched by either flame it is dissipated, immediately, in imparting a brilliant green colour to the flame border. The brown deposit is not readily seen on charcoal; but if the metal be fused on a cupel, or on a piece of thin porcelain or other non-reducing body, the evolved fumes are almost wholly of a brownish colour, and the deposit is in great part brownish black. It would appear, therefore, to consist of Tl_2O_3, rather than of a mixture of metal and oxide. On the cupel, thallium is readily oxidised and absorbed. It might be employed, consequently, as suggested by Crookes, in place of lead, in cupellation; but to effect the absorption of copper or nickel a comparatively large quantity is required. When fused on porcelain the surface of the support is strongly attacked by the formation of a silicate, which is deep red whilst hot and pale yellow on cooling.

The teroxide, as stated by Crookes, evolves oxygen when heated, and becomes converted into Tl_2O. The latter compound is at once reduced on charcoal, and the reduced metal is rapidly volatilised with brilliant green colouration of the flame. The chloride produces the same reaction, by which the green flame of thallium may easily be distinguished from the green copper flame, the latter, in the case of cupreous chlorides, becoming changed to azure-blue. With borax and phosphor-salt, thallium oxides form colourless glasses, which become grey and opaque when exposed for a short time to a reducing flame. With carbonate of soda they dissolve to some extent, but on charcoal a malleable metallic globule is obtained. The presence of soda, unless in great excess, does not destroy the green colouration of the flame.

Thallium alloys more or less readily with most other metals before the blowpipe. With platinum, gold, bismuth, and antimony, respectively, it forms a dark gray brittle globule. With silver, copper, or lead, the button is malleable. With tin, thallium unites readily, but the fused mass immediately begins to oxidise, throwing out excrescences of a dark colour, and continuing in a state of ignition until the oxidation is complete. In this, as in other reactions, therefore, the metal much resembles lead.

II. *On the Opalescence produced by Silicates in Phosphor Salt.*

It is well known that most silicates when fused with phosphor-salt are only partially attacked, the bases, as a rule, gradually dissolving in the flux, whilst the silica remains in the form of a flocculent mass technically known as a "silica skeleton." Very commonly, almost invariably, indeed, if the blast be long continued, the bead becomes more or less milky or opalescent on cooling. This latter reaction was apparently regarded by Plattner as essentially due to the presence of alkaline or earthy bases, such as exhibit the reaction *per se*. He states (*Probirkunst: Dritte Auflage*, 468):—"Da man nun von mehreren Silikaten ein Glas bekommt, welches, so lange es heiss ist, zwar klar erscheint, aber unter der Abkühlung mehr oder weniger opalisirt, so muss man sich von der ausgeschiedenen Kieselsaure überzeugen, so lange das Glas noch heiss ist, und dabei die Loupe zu Hülfe nehmen. Die so eben erwähnte Erscheinung tritt gewöhnlich bei solchen Silikaten ein, deren Basen Kalkerde, Talkerde, Beryllerde oder Yttererde sind, die für sich mit Phosphorsalz, bei gewisser Sättigung des Glases, unter der Abkühlung oder durch Flattern milchweiss oder opalartig werden." Dr. Theodor Richter, the editor of the fourth edition of Plattner's work, leaves out the "gewöhnlich" of the above quotation, and so makes the implication still stronger. In this *vierte Auflage* the statement runs—"Bei solchen Silikaten deren Basen für sich mit Phosphorsalz, bei gewisser Süttigung des Glases, unter der Abkühlung oder durch Flattern milchweiss oder opalartig werden (Kalkerde, Talkerde, Beryllerde, oder Yttererde) wird die Perle unter der Abkühlung mehr oder weniger trübe." It is true enough that silicates in which these bases are present exhibit the reaction; but as other silicates—practically all, indeed—exhibit the reaction also, the inference implied in the above statement is quite erroneous. The opalescence of the glass arises entirely from precipitated silica. If the blast be sufficiently kept up, a certain amount of silica is almost always dissolved, but this becomes precipitated as the glass cools. A simple experiment will show that this is the true cause of the opalescence. If some pure silica (or a silicate of any kind), in a powdered condition, be dissolved before the blowpipe flame in borax until the glass be nearly saturated, and some phosphor-salt be then added, and the blowing be continued for an instant, a precipitation of silica will immediately take place, the bead becoming milky—or, in the case of many silicates, opaque-white—on cooling. This test may be resorted to for the detection of silica in the case of silicates which dissolve with difficulty in phosphor-salt alone, or which do not give a well-pronounced "skeleton" with that reagent.*

* Communicated by the Author.

† The reactions given by Crookes are as follows:—"The metal melts instantly on charcoal, and evolves copious brown fumes. If the bead is heated to redness, it glows for some time after the source of heat is removed, continually evolving vapours which appear to be a mixture of metal and oxide. A reddish amorphous sublimate of protoperoxide surrounds the fused globule. When thallium is heated in an open glass tube, it melts and becomes rapidly converted into the more fusible protoxide, which strongly attacks the glass. This oxide is of a dark red colour when hot, solidifying to a brown crystalline mass. The fused oxide attacks glass and porcelain, removing the silica. Anhydrous peroxide of thallium is a brown powder, fusing with difficulty and evolving oxygen at a red heat, becoming reduced to the protoxide. The phosphate and sulphate will stand a red heat without change."

* By whom was the formation of a "silica skeleton" first made known? There is no reference to it in the early treatise of Von Engerstrom attached to his translation of Cronstedt's "Mineralogie" (ed. 1, 1770; ed. 2, by John Hyacinth de Magellan, 1788), although phosphor-salt is mentioned as a reagent under the term of *sal fusibile microcosmicum*, and was indeed used by Cronstedt before 1758, the year in which his "Mineralogie" was anonymously published. Bergmann, who followed as a blowpipe worker, states that "siliceous earth" is very slowly attacked by microcosmic salt, but he does not

III. *On the Reactions of Chromium and Manganese with Carbonate of Soda.*

When a mineral substance is suspected to contain manganese it is commonly tested by fusion with carbonate of soda. But chromium compounds form with that reagent a green enamel much resembling that formed by compounds of manganese.

The chromate-of-soda enamel, however, is yellowish green after exposure to an oxidating flame, and the green colour never exhibits any tinge of blue.

The manganate-of-soda enamel, on the other hand, is generally greenish blue when quite cold.

To avoid, however, any risk of error in the determination, the bead may be saturated with vitrified boracic acid until all the carbonic acid is expelled, and a clear glass is obtained. The chrome glass will retain its green colour, whilst the manganese glass will become amethystine or violet. In place of boracic acid, silica may be used if more convenient. In this case the reaction is assisted by the addition of a very small amount of borax.

IV. *On the Detection of Cadmium in the Presence of Zinc, in Blowpipe Experiments.*

When cadmiferous zinc ores, or furnace products derived from these, are treated in powder with carbonate of soda on charcoal, the characteristic red-brown deposit of cadmium oxide is generally formed at the commencement of the experiment. If the blowing be continued too long, however, this deposit may be altogether obscured by a thick coating of zinc oxide. When, therefore, the presence of cadmium is suspected in the assay substance, it is advisable to employ the following process for its detection:—The substance, if in the metallic state, must first be gently roasted on a support of porcelain or other non-reducing body. Some of the resulting powder is then fused with borax or phosphor-salt on a loop of platinum wire, and bisulphate of potash in several successive portions is added to the fused bead. The latter is then shaken off the wire into a small porcelain capsule, and treated with boiling water. A bead of alkaline sulphide is next prepared by fusing some bisulphate of potash on charcoal in a reducing flame, and removing the fused mass before it hardens. A portion of the solution in the capsule being tested with this, a yellow precipitate will be produced if cadmium be present. The precipitate can be collected by decantation or filtration, and tested with some carbonate of soda on charcoal. This latter operation is necessary, because if either antimony or arsenic were present an orange or yellow precipitate would also be produced by the alkaline sulphide. By treatment with carbonate of soda on charcoal, however, the true nature of the precipitate would be at once made known.

To be continued.)

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.†

By JAMES MACTEAR.

(Continued from p. 5.)

Part II.—Sulphuric Acid.

The substitution of dilute sulphuric acid for sour milk in the old system of bleaching, which had the effect of reducing the time required by nearly one-half, gave rise to a demand for vitriol in considerable quantity, and to supply this demand a work was erected in 1749, at Prestonpans.

I have been unable to find any evidence of the manufacture of sulphuric acid in Scotland previous to this date.

As is well known, the first method of producing sulphuric acid was by the distillation of sulphate of iron or *green vitriol*.

This was followed by a method of burning sulphur under a bell glass moistened with water, and the acid (produced in very small quantity) is said to have been sold at 2s. 6d. per oz.

In 1740, MM. Lefévre and Lémery proposed the addition of nitrate of potash to the sulphur, and suggested that the combustion could then be carried on in closed vessels. This idea was taken up in England by a Dr. Ward, who used large glass vessels holding about 300 litres, and containing at the bottom a small quantity of water.

A small capsule, supported on a stoneware stand, was charged with a mixture of one of nitre and eight of sulphur. This was set on fire and the neck of the vessel closed. After the combustion had ceased, fresh air was allowed to enter the vessel, and these operations were repeated until the acid was sufficiently strong for concentration in glass retorts. This acid was sold at about 2s. per lb.

Dr. Roebuck, of Birmingham, improved on this process by erecting a leaden vessel of about 6 ft. square as a substitute for the glass ones previously in use. This was in 1746, and works were erected by this gentleman and a Mr. Garbett, in the year 1749, at Prestonpans, on the east coast of Scotland.

This, then, was the beginning of the sulphuric acid manufacture in Scotland. Other works were soon erected, and in 1797 there were in Glasgow alone at least six or eight different works.

In this year the question of the strength of the commercial vitriol seems to have received a good deal of attention, and a set of hydrometers were invented or arranged by a Mr. Foy, a chemist at that time engaged in bleaching operations.

The following is a note of the cost of manufacturing 950 bottles of vitriol (of 150 lbs. each).

"*Mr. M——'s Business*, 1798."

25 tons sulphur—say at £40				£1000	0	0
7 „ nitre „ 100				700	0	0
Coals				105	0	0
Wages and houses for men				250	0	0
Tear and wear of utensils				30	0	0
Rent and buildings				70	0	0
Cartages				40	0	0
				£2195	0	0
142, 500 lbs. o. v. at 6¼d.	£3859	17	6			
Less discount at 10 per cent	385	19	9			
				3473	17	9
Profit				£1278	17	9

This gives nearly 64 tons of acid, costing, say, £32 per ton, and selling for, say, £54 net cash.

Description of method of working then in use by Messrs. Bealy and Radcliffe, near Manchester:—

May, 1799.—"There were six chambers, 12 ft. by 10 ft. by 10 ft., roofed like a cottage. They were placed in houses having openings in the brick walls, leaving the lead to be exposed to the atmosphere.

"This is perhaps of more use in expediting the filling of the chambers with fresh air than in aiding condensation. Mr. Laird (a Glasgow manufacturer of the period) says that the hotter the chambers are kept the condensation is the more perfect.

"Each of these chambers has a valve, which is opened between the burnings.

"In them there is burned each week 1386 lbs. sulphur and 198 lbs. nitre, burnt in double pans, the larger above

seem to have remarked the skeleton formation in the case of any silicate. The reaction appears to have been first definitely pointed out by Berzelius in his standard work on the Blowpipe, published in 1821. It was therefore most probably discovered by him, or perhaps—as he lays no claim to its discovery, whilst claiming to be the originator of other tests—it may have been communicated to him by Garn?

† Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

the lesser, and yielding 1800 lbs. of O.V. of 1·8 sp. gr. (equal to a produce of 130 per cent on sulphur, with 14·28 per cent of nitre).

"8 to 9 inches of water on the floor of the chamber.

"The sulphur and nitre are mixed in the proportion of one of nitre and seven of sulphur.

"Of this mixture 8 lbs. are burned in each chamber every four hours. The mixture is burned on iron plates or trays, of which there are two sets only in each chamber (more not being found so productive), each set consisting of two plates, one placed over the other, about 3½ inches apart.

"The iron is of best quality and very thin, so that they heat quickly. They are supported on a frame, which can be drawn out at the door of the chamber.

"One pound weight of the mixture is put upon a lower plate, and 3 lbs. on the upper plate.

"The plates being charged, the lower plates are first ignited, and when fairly lit, then the upper plates; the frame is then pushed into the chamber and the door shut.

"The whole will be finished burning in one hour.

"Charge again three hours, after the burning is over, or once every four hours, opening the doors and valves a quarter of an hour beforehand.

"The plates to be cleaned each time.

"By keeping this going on, they, in six weeks, make their O.V. attain a gravity of 20 ozs. (1·250 sp. gr.), when it is run off for concentration to 22 ozs. (1·375 sp. gr.), when it is used for bleaching liquors, &c.

"Having six chambers, therefore, affords one for drawing off each week.

"*State agreeable to the above.*

"1386 lbs. sulphur, at £22	£13	12	3
"198 „ nitre „ 64	5	13	1½
"Labour	1	1	0
"Tear and wear	1	1	0
	£21	7	4½
"Off for drawback on sulphur, at £6 12 8 per ton	4	2	0½
"Producing 1800 lbs. O.V., costing	£17	5	4

"Equal to 2½d. per lb. or £21 10s. per ton.

"Interest on sunk capital omitted in this state."

The prevalent theory held at this time may be seen from the subjoined note.

"When sulphur is heated to 302°, it burns with a blue flame, and the produce is chiefly sulphurous acid.

"When sulphur is heated to 570° it burns with a white flame, and the produce is sulphuric acid."

Numberless experiments were conducted with the view of being able to burn the sulphur at the proper degree of heat which should yield only sulphuric acid.

The fact that a quantity of nitrate of potash only equal to 1-8th of the oxygen required was sufficient for practical purposes, seems to have given rise to the most extraordinary ideas at this time.

The following calculations give a good illustration:—

"100 of nitrate of potash according to Kirwan, contains 41·2 of nitric acid, 46·15 potash, and 12·83 water.

"The acid of nitre consists of 7 of oxygen and 3 of azote; hence 100 nitrate of potash contains 28·7 of oxygen.

"100 of sulphur, it appears, from Kirwan, requires 140 of oxygen to saturate it, or convert it all into sulphuric acid.

"100 acid, therefore, consists of 41·67 sulphur and 58·33 oxygen.

"Consequently 100 sulphur would require the oxygen of 525 of nitrate of potash for complete saturation.

"When, therefore, the maker of sulphuric acid adds 10 of nitre to 100 of sulphur, he has only 2·8 of oxygen, which will saturate only 2 of sulphur.

"Now 10 of nitrate of potash contains 4·612 of alkali; that alkali is converted into sulphate of potash, and requires for this 4·5 sulphuric acid in that state in which it exists in the sulphate of potash (it contains, by Kirwan, 45 acid and 55 potash). *That is, the potash of the nitre takes more acid than is produced by the oxygen contained in the nitre with its proper proportion of sulphur.*

"The nitre, therefore, used in the manufacture of sulphuric acid does not produce *any* acid which the manufacturer can be the better of. It produces no sulphuric acid in an uncombined state. The only other purpose it can serve is to produce such rapid inflammation of the sulphur as will be productive of sulphuric instead of sulphurous acid; *that is, it produces a white flame and the temperature of* 570°.

"Even with nitre a great deal of blue flame is present, and consequently much sulphurous acid formed, and this sulphurous acid is all lost to the manufacturer, as it flies off in the operation.

"The manufacturer, at most, produces from 100 sulphur, 168 of marketable oil of vitriol of 1·846 sp. gr.

"But 100 parts of sulphuric acid at this strength is equal to 89 at 2·000, which Kirwan calls his standard acid, and 100 standard acid is equal to 89·25 of acid, such as exists in sulphate of potash, or 100 parts acid at 1·846 sp. gr. are equal to 78, as existing in sulphate of potash.

"The manufacturer, therefore, only gets 125·6 acid, such as exists in sulphate of potash, whereas 100 parts sulphur should produce 240 parts of such acid, deducting 2 parts, which go to form the sulphate, leaving 238 parts.

"These 238 parts are equal to 290 at 1·846 sp. gr., which ought to be the produce, instead of 168.

"Hence only 55 parts of the 100 sulphur used go to form sulphuric acid, and 45 parts are lost.

"Some part of this 45 may indeed be impurities—allow 5 per cent on this account—still the manufacturer loses 40 parts in every 100 of sulphur.

"This 40 parts is converted into sulphurous acid, and is lost."

The only way to prevent this is to burn the sulphur with a white flame, and by raising the temperature in which it is burnt to 570°.

At the Prestonpans Works in 1800 *they used, per* 112 *lbs of O.V.*:—

100·8 lbs. of sulphur, at 7s.. ..	£0	6	3
13·06 „ nitre, at 36s.	0	4	2
All other expenses	0	10	7
Cost delivered to purchasers ..	£1	1	0

The selling gross price being about £60 per ton. This is equal to a production of, say, 198 per cent acid, 1·84 sp. gr., with 13 per cent nitre.

The size of these chambers was most likely the same as given in 1813, when they had 108 chambers, 14 ft. long, 10 ft. high, and 4½ ft. wide. In 1805, a work existed at Burntisland which employed no less than 360 chambers, each 8 ft. long, 6 ft. high, and 4 ft. wide, containing 192 cubic ft. each.

Water equal to 70 or 80 gallons (5 to 6 inches) was run on the bottom, and the charge was 1 lb. of a mixture of 1 nitre to 6 of sulphur every four hours, half an hour allowed for ventilation.

The burning was continued for ten weeks, in which time 36 chambers yielded 60 bottles rectified acid. This being the weekly produce of the works:—

Produce	173 per cent O.V., 1·84 sp. gr.
Nitre	16·6 „

Many more such details might be given, but it will be more instructive to trace the development of this manufacture in the progress of the St. Rollox Chemical Works.

These works were erected in 1799, for the production of bleaching-powder, a patent for which had been secured by Mr. C. Tennant in the previous year. Considerable quantities of sulphuric acid were required for this manufacture, and were purchased from the various local makers, from the Prestonpans Vitriol Company, and supplies were even brought from Halifax.

The price at this time being about £60 per ton delivered.

The consumption increasing rapidly, chambers were erected at St. Rollox in 1803; these were six in number, and seem to have been 12 ft. by 10 ft. by 10 ft., costing to erect about £50 each.

The house in which they were contained was of three floors, about 50 ft. long by 24 ft. wide—the upper contained the chambers, the next the glass retorts for concentrating the acid, and the lower the leaden evaporating boilers, used in bringing the acid up to strength for the glass retorts.

The system upon which these chambers were worked, was that as already described as in use by Messrs. Bealy, and the quantity of sulphur burned was about 1000 lbs. weekly, with about 14 per cent nitre.

Various modifications of this system were tried, chiefly to improve the yield by charging less often, until the question of how to deal with the residues became a serious one, and in 1807 a third plate was added, on which the residues, or "sulphur ashes," were re-burned, mixed with a little fresh nitre.

This succeeded so well that considerable quantities of these residues were purchased from the other makers over the country, and used up in this way.

These sulphur ashes contained from 25 to 50 per cent when only once burned, and cost about £5 per ton.

At the end of this year, a brick furnace, heated artificially, was attached to one chamber, and in a short time two chambers were attached to one furnace, which was placed between them and had a flue to each chamber.

The furnace burned the sulphur ashes mixed with a portion of fresh sulphur and nitre. It worked almost continuously, the gas passing into one chamber for a certain time, the other meanwhile being shut off by means of a damper, then the first chamber damper was closed and the second opened. No. 1 chamber was allowed to condense for some time, and then the air valves and doors were opened to let in a fresh supply of air.

There were 14 chambers at work in this year, during which a produce of about 200 of acid of 1·84 sp. gr. seems to have been obtained from 100 sulphur with 15 per cent nitre. At the end of 1809, there were in operation 26 chambers.

In 1811, furnaces heated externally were applied to all the chambers, which were increased in number to 32, arranged in sets of two or three each.*

Sulphur ashes were used in large quantity.

The strength of the chamber acid, which had hitherto only been about 50° to 60° T., was gradually raised, and steam having been introduced about 1813 or 1814, a strength of 100° to 120° T. was attained, and the process became more or less a continuous one.

From this time till about 1840, the changes in the manufacture were chiefly in the direction of improving the form of the apparatus, both in chambers and furnaces.

Pyrites was first used in 1840.

Communications with Hill, show that he was using pyrites in 1820 in a chamber 50 ins. by 26 ins. by 22 ins.; and Gay-Lussac's method of recovering the nitrous compounds by absorbing them in strong vitriol, in 1844 introduced by a Mr. De Courcy.

This was followed almost immediately by Mr. C. T. Dunlop's method of manufacturing bleaching-powder by the decomposition of a mixture of salt and nitrate of soda, which gives off a mixture of chlorine and nitrous acid. The latter is absorbed in strong vitriol and used as the source of nitrous acid in the chambers.

Various methods of denitrating this nitrous vitriol were from time to time tried, and the most successful, perhaps, prior to the introduction of the Glover tower was a wall of coke extending across the chamber, through which all the gases had to pass while it was kept supplied with nitrous vitriol at various points so as to expose it in as thin films as possible. This method worked extremely well for many years.

The methods now in use in the manufacture at these works differ but little from the general system in use by the other large manufacturers of Great Britain.

The following list of vitriol makers in England is interesting, compiled in 1820.

* Red-hot plates of about a foot square and ¾ inch thick in use generally by the makers.

CHRONOLOGY—SULPHURIC ACID—GLASGOW, &c.

Works.	Date.	No. of Chambers.	Length.	Breadth.	Height.	Method of Burning.	Produce from 100 Sulphur at 1·84 sp. gr.	Per cent Nitre.	Cost per Ton.	Remarks.
			Feet.	Feet.	Feet.				£.	
Mr. M——'s..	1798	—	—	—	—	On plates	200?	28	32	25 tons sulphur, strength of acid unknown, if 148° yield would be 200%.
Bealy's	1799	6	12	10	10	,,	130	14¼	21 10/	Cottage roofs—run off each 6 weeks.
Prestonpans ..	1800	108	14	4½	10	,,	198	13	21	Cost delivered to customers—run off in 10 weeks.
Burntisland ..	1805	360	8	4	6	,,	173	16·6	—	Cost not known.
Nisbet	1805	—	—	—	—	—	187	25	29	Small work.
A. W. and Co.	1805	6	—	—	—	—	187	19	28 15/	
W. N.	1811	—	—	—	—	—	200	23	—	Sulphur ashes re-burnt on red-hot plates.
Prestonpans ..	1812	108	14	4½	10	—	220	Unknown	—	Do. Do.
Do. ..	1813	108	14	4½	10	—	—	—	—	400 to 500 glass retorts at work two charges per wk. Chambers in 9 sets of 12 each, 1 set run off each week.
Kenny, Dublin	1813	2	45 25	17 17	10 12	—	—	—	—	
J. L——d ..	1813	—	—	—	—	—	200	20·8	—	
Camlachie ..	1820	—	—	—	—	—	263*	13	—	*Acid strength supposed to be 144°T.
Porte Dundas	1824	1	70	18	—	—	246*	—	—	* Do. Do.
St. Rollox ..	1803	6	12?	10?	10?	—	—	14	—	
Do. ..	1806	—	—	—	—	—	185	12	20 13/	
Do. ..	1807	—	—	—	—	—	193	15½	18 15/	
Do. ..	1809	26	No	Record		—	—	—	—	
Do. ..	1811	32	60?	14?	12?	Furnace	—	—	—	

Name.	Situation of Works.
Brandrum and Co.	London.
Farmer	,,
Smith	,,
Hill	,,
D. Taylor and Sons	,,
Liddiard	,,
Dobbs	,,
Skey and Beudley	Staffordshire.
Caves and Co.	Bristol.
Bush	,,
Dobbs	Birmingham.
Austen	,,
Phipson	,,
Paton	,,
Bower and Sons	Leeds.
Norris and Son	Halifax.
Betson	Rotherham.
Doubleday, Easterby, & Co.	Newcastle.
Rawson and Sons	Bolton.
,, ...	,,
Watkins	Manchester.
Mutrie and Co.	,,
,, ...	Whitehaven.

23 works in all at this date.

(To be continued).

NOTE ON A CRYSTALLISED COMPOUND OF SALT AND WATER.

By E. BEVAN.

SODIC chloride is to a certain extent soluble in hot hydrochloric acid. This solution deposits on cooling long needle-like crystals composed of salt and water. A specimen of the dried crystals gave on analysis the following results:—

NaCl	94·50 (mean of 4 analyses)
H_2O	5·48

They contained only a very slight trace of hydrochloric acid. After a time the crystals appear to break up into the ordinary form of salt crystals containing no water.

ON THE CALCULATION OF THE PERCENTAGE OF CHEMICALLY COMBINED CARBON IN ANALYSES OF STEELS BY EGGERTZ'S COLORIMETRIC METHOD.

By SERGIUS KERN, St. Petersburg.

I SUPPOSE that in many laboratories of iron works, where a couple of analyses of steel-castings are made every day analysts prepare tables by means of which, knowing the quantity of c.c. of the normal and specimen solutions of steels used to receive an equal colouration, the percentage of carbon is easily found out.

The following remarks may be of some use, especially as no method for a quick calculation of carbon can be found in manuals of chemistry; even Eggertz in his book on Iron Analyses gives no information on this subject. Eggertz's colorimetric method is well known, so that it is of no use explaining it. I merely mention that it is better to dissolve the normal steel and the specimen in equal quantities of nitric acid (8 c.c.), and in comparing the test-liquors to dilute them by nitric acid, 1·2 sp. gr., instead of using water as recommended by Eggertz.

In all my examples for calculating the percentage of carbon I suppose having 8 c.c. of the normal solution, prepared from 0·1 grm. of normal steel containing 0·31 per cent of carbon, very carefully determined by the combustion method. On the other hand, 8 c.c. of the specimen solution is prepared from 0·1 grm. of the analysed steel.

In calculating the percentage of carbon two cases may happen:—

1. The specimen solution is *darker* in colour than the normal solution.
2. The specimen solution is *lighter* in colour than the normal solution.

I. *The specimen solution is darker.* 8 c.c. of the normal solution contains 0·31 per cent of carbon: hence 1 c.c of the same solution contains—

$$\frac{0{\cdot}31}{8} = 0{\cdot}0038 \text{ per cent of carbon.}$$

In comparing the specimen solution it was diluted by

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

TABLE I.—SCOTTISH BLACKBAND IRONSTONE, RAW AND CALCINED.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.	VIII. Slateyband.	IX. Slateyband.
Protoxide of Iron	32·14	41·65	44·19	45·78	46·59	42·02	47·31	32·14	29·83
Protoxide of Manganese	1·05	—	1·93	1·12	1·12	0·82	1·67	0·96	1·48
Lime	2·82	5·76	2·22	1·79	1·68	3·65	1·79	0·83	2·37
Magnesia	1·08	3·52	0·91	1·30	2·25	3·54	1·73	1·05	0·30
Carbonic Acid	22·87	33·06	30·74	30·95	32·19	32·61	32·71	21·64	21·13
Phosphoric Acid	0·82	0·84	0·43	0·55	0·78	0·46	0·59	0·43	0·24
Sulphur	0·22	0·25	0·22	3·28	0·14	trace	trace	7·48	9·50
Iron combined with Sulphur ..	0·19	0·22	0·19	2·87	0·12	—	—	6·54	8·31
Alumina	7·06	0·96	0·92	1·28	2·34	2·64	0·80	4·12	1·44
Silica	12·40	0·52	2·12	1·60	3·44	4·40	1·20	7·12	1·90
Coal and Bituminous matter ..	18·60	11·16	15·52	7·85	8·97	9·12	10·40	17·17	22·70
Water	0·75	2·04	0·61	1·63	0·41	0·74	1·80	0·52	0·80
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron, per cent	25·19	32·62	34·56	38·47	36·36	32·68	36·80	31·54	31·51
Specific gravity	2·533	3·030	2·791	3·078	2·830	2·857	2·941	2·727	—
Yield of Calcined Ore, per cent	61·28	58·20	56·41	60·85	63·60	62·26	60·48	59·64	52·85
Iron in Calcined Ore, per cent ..	41·10	56·04	61·27	63·23	57·16	52·50	60·85	52·88	59·61
Silica in Calcined Ore, per cent	20·24	0·90	3·76	2·63	5·41	7·06	1·98	11·94	3·60

(To be continued.)

1 c.c. of nitric acid, in order to obtain the tint of the normal solution. The total volume of this solution is hence 9 c.c.

0·0038 × 9 = 0·0342 per cent of chemically combined carbon in the specimen analysed.

II. *The specimen solution is lighter.* In this case the normal solution must be diluted to obtain an equal tint with the specimen solution. 8 c.c. of the normal solution were diluted by 2 c.c. of nitric acid. The total volume of the liquor is hence 10 c.c. One c.c. of this solution contains—

$$\frac{0{\cdot}31}{10} = 0{\cdot}031 \text{ per cent of carbon.}$$

The volume of the specimen solution remains always in this case 8 c.c., so that the percentage is very easily found out:—

0·031 × 8 = 0·248 per cent of carbon in the analysed specimen.

By means of these calculations, knowing the per cent of carbon in the normal steels, tables may be very easily calculated and prepared.

Obouchoff Steel Works, St. Petersburg.

PROCEEDINGS OF SOCIETIES.

THE CHICAGO CHEMICAL SOCIETY.

A few gentlemen interested in the advancement of the science of chemistry held a meeting at the Sherman House Club-room, Chicago, November 29, 1876, to consider the advisability of forming a chemical society. There were present Profs. Hayes, Siely, Ebert, Wheeler, Rodney Welch, J. T. Bergen, jun., and Prof. Garretson, who was elected Chairman. All the gentlemen expressed themselves in favour of organising an association. Its objects would be not only to keep its members abreast with the latest discoveries in the science, but also to further original research.

Some discussion followed as to whether the proposed society should be made a section of the Academy of Sciences, or start out on an independent footing. Prof. Hayes favoured the Academy, although it was true it had much degenerated now from its palmy days before the fire, when it ranked as the third institution of the kind in the country. He thought the extra expense of such a connection would be more than made up by the facilities it would afford in apparatus, chemical journals, &c. It was decided that after the association was formed it could then, if desirable, join the academy.

A formal motion was made by Prof. Welch that those present organise a chemical society, its name to be confirmed hereafter. The motion was carried unanimously.

The following gentlemen were appointed a Committee on Constitution and Bye-laws:—The Chairman, and Profs. Wheeler and Ebert.

The same gentlemen were then instructed to consider the best quarters to be occupied by the new society temporarily. The lecture-room of the Chicago Homœopathic College, and also that of the College of Pharmacy, were suggested. The Committee will bring in reports on both subjects at the next meeting.

The Secretary (Mr. Bergen) was instructed to inform local chemists of the organisation of the society, and to ask their co-operation.

After some further discussion it was decided to have the first paper read at the next meeting, and Prof. Wheeler was assigned to that duty.

NOTICES OF BOOKS.

Lessons in Electricity at the Royal Institution, 1875-6. By John Tyndall, D.C.L., LL.D., F.R.S. London: Longmans and Co., 1876.

This little work presents in the space of 113 pages a succinct account of the principal phenomena of frictional electricity. It comprises, in a somewhat condensed form, the short course "adapted to a juvenile auditory" which Dr. Tyndall gave at the Royal Institution last Christmas. The book is mainly distinguished from the fact that all the experiments are performed in the simplest possible manner; there is no elaborate apparatus, and the youngest student of science can make for himself almost everything which he is directed to use. The subject-matter is divided into thirty-two sections, commencing with Historic Notes, and passing on to Attraction and Repulsion, Conduction and Insulation, Electrics and Non-Electrics, the Two-Fluid Theory, Induction, the Electrophorus and Machine, the Leyden Jar, Atmospheric Electricity, and the Return Shock. We must not neglect to refer specially to the third section, which is entitled the "Art of Experiment." An historic sketch of the science having been given, we must next study the facts, and learn to produce and extend them. "The art of producing and extending such facts, and of enquiring into them by proper instruments, is the *art of experiment.* It is an art of extreme importance, for by its means we can, as it were, converse with Nature, asking her questions, and receiving from her replies. It was the neglect of experiment, and of the reasoning based upon it, which kept the knowledge of the ancient world confined to the single fact of attraction by amber for more than 2000 years. . . . In this way you will come into direct contact with natural truth—you will think and reason, not on what has been said to you in books, but on what has been said to you by Nature. Thought springing from this source has a vitality not derivable from mere book knowledge."

Finally, Dr. Tyndall addresses some parting words to Head Masters on the subject of science teaching in their schools:—"To them, moreover, I would say, in words of friendly warning, make room for science by your own healthy and spontaneous action, and do not wait until it is forced upon you from without. The condition of things now existing cannot continue. Its simple statement suffices to call down upon it the condemnation of every thoughtful mind. With reference to the report of a Commission appointed last year to enquire into the scientific instruction of this country Sir John Lubbock writes as follows:—'The Commissioners have published returns from more than a hundred and twenty of the larger endowed schools. In more than half of these no science whatever is taught; only thirteen have a laboratory, and only eighteen possess any scientific apparatus. Out of the whole number, less than twenty schools devote as much as four hours a week to science, and only thirteen attach any weight at all to scientific subjects in the examinations.' Well may the Commissioners pronounce such a state of things to be nothing less than a national calamity! If persisted in, it will assuredly be followed by a reaction which the truest friends of classical culture in England will have the greatest reason to deplore."

A Practical Treatise on Materia Medica and Therapeutics. By Roberts Bartholow, M.A., M.D. New York: D. Appleton and Co., 1876.

The above treatise is, perhaps, the most philosophically written work on Materia Medica and Therapeutics which has yet appeared on the other side of the Atlantic. The subject is treated entirely from the therapeutist's point of view, and all chemical, pharmaceutical, and botanical details are left out. Dr. Bartholow begins by describing the various routes by which medicines are introduced into the organism; inhalation, transfusion, and hypodermic injection being specially dwelt upon. He next proceeds

to describe the medicines themselves, and their effects on the various organs, dividing them into five great classes, viz.—Those used to promote constructive metamorphosis; those used to promote destructive metamorphosis; those used to act on the nerves; purgatives of all descriptions; and, lastly, topical remedies. Beginning with aliments, Dr. Bartholow carries his readers through the different kinds of animal and vegetable foods, describing their particular uses in various forms of disease, with remarks on special plans of diet, including a general description of the grape, whey, milk, koumiss, and buttermilk cures. The different forms of water cure also come in for a large share of attention. The work now enters on the domain of medicaments proper, pepsin being taken as the boundary stone. The article on iodine and its preparations, which is particularly complete, may be taken as a typical specimen of the systematic manner in which Dr. Bartholow has handled his subject. He begins by giving a description of iodine and its preparations, their general properties and doses. This is followed by a list of antagonists, incompatibles, and adjuvants, or synergists as the author prefers to call them. Next we have an account of their physiological action, including the symptoms and effects of iodism. To this succeeds the therapy of the remedies, this division of the article naturally receiving the largest amount of attention, the whole concluding with a copious list of European and American authors who have written and experimented on the subject. It will be seen from this description that each article is an exhaustive monograph as far as therapeutics go. Many of the newer remedies—such as chloral hydrate, croton-chloral hydrate, amyl nitrite, apomorphia, gelsemium sempervirens, and jaborandi—are fully treated of, the information being brought down to the latest date.

Although the work is so complete in its individual treatment of each particular remedy that is described, we cannot help expressing surprise that certain drugs and compounds, which must be as well known in America as in Europe, should have been entirely omitted. Such an important article of diet as lime-juice is not even alluded to, and we can find no mention of bebceria sulphate, *Cannabis Indica*, sumbul, Bael, syrup of chloral, and several other preparations, which, being officinal in the British and other Pharmacopæias, should not have been passed over in silence.

The work is provided with a double index, one to the remedies, the other to the diseases. Both of them are far too meagre for such a work as the present. For instance, in the Index of Diseases one of the most important remedies in tetanus, hypodermic injection of morphia, is omitted, although fully described in the text, and hydrophobia is left out altogether. But these defects detract but little from the real value of the work, every page of which teems with information, the gathering together of which must have cost Dr. Bartholow many years of anxious toil. Perhaps the highest praise we can give it is to say that it must take its place in every therapeutist's library side by side with Flückiger and Hanbury's "Pharmacographia."

To the scientific chemist who glances through Dr. Bartholon's book, and looks on the subject from a purely chemical point of view, it must be a matter of surprise to find how few remedies have been sought for in the laboratory. Taking the last twenty years, the number of purely chemical remedies that have been introduced into pharmacy may be counted on the fingers, and yet during that time chemists have enriched the world with tens of thousands of artificial acids, alkaloids, and neutral bodies, some of which, *a priori*, ought surely to have a high therapeutical value. The vegetable alkaloids are amongst the most powerful weapons in the therapeutist's armoury, and their artificial congeners, many of which approach them so closely in atomic constitution, cannot be totally worthless. The field open for research in this direction is almost boundless, and if cultivated on true scientific principles ought to yield a large harvest.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—Allow me to trespass on your space in the character of a Fellow (indeed, as regards a period when I had more time on my hands, and, so far as mineral analysis went, a working Fellow) of the Chemical Society.

A dozen or so years ago I suggested that our Society should take upon itself the duties of an examining body. My proposal was instantly snuffed out. But that a test should exist of competency to exercise the profession of a chemist was then a crying want, and is far more so now, especially with the newly-created regiment of Public Analysts. To meet this want we have a separate "Institution of Chemists," as I am (unofficially) aware, in course of formation, and, I hope, with success. In fact, the river of scientific organisation *will* flow, increased by numerous affluents, and if the authorities of the Chemical Society will not bear the honourable burthens that are thereby all but forced upon them on their heads be the neglect.

But how is it, Sir, that we Fellows have never been consulted, called to any meeting, or officially communicated with in any way by the Council? Is a great movement to be dealt with without any reference to the constituency by our little Parliament? Is not this for our representatives to take upon themselves to be our masters rather than our servants? So far has this been carried out that I have been unable to obtain copies of counsel's opinion upon the powers of organisation under our charter, although I have applied for such, and have even been shown printed copies! And, though not at all behind the scenes of this absurd and needless mystery, I perceive that the very natural course of asking question produces a state of irritation, as if one had some malevolent motive in presuming to learn what, as a Fellow, I may fairly term one's own business! Evidently, though a council, a board of directors, or any corporation would not be wise in making the details of their proceedings known to their constituents, yet on the eve of a great and irrevocable movement it is very far from wisdom, courtesy, or respect to allow no opportunity outside their own body of gaining information, of forming a judgment, or expressing an opinion on such vital matters as are now in question. I call upon the Fellows to express their opinions upon this policy of secresy.

Let us shortly look into the matter so far as our involuntary ignorance will allow of our doing. The Charter of the Chemical Society is sufficiently broad to enable us to provide for most of the great wants proposed to be met by the formation of a new body not possessing any legal privilege, with a few exceptions, the one probably most important being the absence of any power in the Council to depute their functions to persons outside their body. This, however, would not preclude a sub-committee acting in the name of the whole.

I believe that we should obtain consideration for any proper representations made by us to Her Majesty, and I understand the Royal College of Surgeons successfully took a similar course some three years since, a very different thing, pray observe, from asking for a Charter for a new body.

Whether or not we should succeed in an application to have a pass examination, or one for honours, recognised I will not give an opinion upon. But a body of which the existence dates by no means from yesterday, and of which a judicious selection by ballot would rapidly raise the prestige, has a great advantage, if only in point of time, over the status of a new and unprivileged examining body!

Great is the British love of precedent and sub-division! I do believe if a society were formed to provide the poor

with soup-tureens, another, holding itself jealously separate, would spring up to provide covers! And I have actually been told that, inasmuch as the College of Physicians and Surgeons are little more than examining and licensing bodies, and that such societies exist as the Medico-Chirugical and others whereat to read papers, so in our case it is best to read our scientific, far more our professional, papers in one place and to examine in another! As if the colleges aforesaid would not have been in a far more exalted position if they also had shrewdly advanced with our times.

Surely, Mr. Editor, it is not even now too late to take action, to the satisfaction of the members of the new body and the κυδος of the old one. As a lawyer I fail to see insuperable difficulty, and, from a lay point of view, I think it only wants the will, good temper, and a certain amount of give-and-take to work as one body with an efficient plan. But there must be a cessation of official *vis inertiæ* and friction, and probably the nomination to the Council of the Chemical Society of several men who have taken a leading part in the present movement, and who would form a well qualified sub-committee of administration.

Allow me, in conclusion, to remark that my standpoint is simply a hearty wish for the prosperity of the old Society and success to the objects, even if carried out separately from it, of the new one. After my Etonian, University, Legal, and Regimental Examinations, I have had about enough of them, and am not in the least likely to offer any body, old or new, ten guineas to renew the agonising tortures of the past.—I am, &c.,

MARSHALL HALL.

13, Old Square, Lincoln's Inn, W.C.,
January 6, 1877.

ESTIMATION OF POTASSIUM AS ACID TARTRATE.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 249) is a letter from Mr. Robert Frazer Smith concerning my process for the "Estimation of Potassium as Acid Tartrate." If Mr. Smith means anything, he probably means that the process I publish is the same as what he published in the *Sugar Cane* more than two years ago. If he had waited to see the rest of my paper I do not think he would have advanced such a claim, and it is an unfortunate circumstance for him that his letter appears in the same number as the second part of my paper. The fortuitous circumstance that I mention that my researches on the estimation of potassium as acid tartrate originated in experiments on the process of Messrs. Duncan and Newlands does not increase the similarity between my process and what he suggested. Neither does the equally fortuitous circumstance that the *Sugar Cane* republished from the *American Chemist* another of my papers, in the "same number of the *Sugar Cane* or a previous one," show that I am guilty of omitting to mention what he considers as his previous claim.

At the date of the publication of Mr. Smith's paper I had already adopted tartaric acid for estimating potassium in sugar solutions, and communicated my results quite freely to chemists who came to my laboratory. I used the volumetric method, which eliminates errors from impurities thrown down with the acid tartrate. Although the process was infinitely more satisfactory than the one used by Mr. Smith, I considered it too crude for publication. It is only lately that the study of the action of acetate of sodium, and the determination of the proper strength of alcohol to be used, have given results which make my processes presentable.—I am, &c.,

P. CASAMAJOR.

Brooklyn, December 28, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 23, December 4, 1876.

Preparation of Alcohol from the Sugar contained in the Leaves of the Beet.—M. I. Pierre.—The nature of this paper may be sufficiently understood from its title.

Measuring Rod of Iridio-Platinum of the International Geodesic Association.—G. Matthey.

Observations on the above Communication.—MM. H. Sainte-Claire Deville, Tresca, Dumas.

Mr. G. Matthey, of the firm of Johnson, Matthey, and Co., of London, has presented to the Academy of Sciences a measure of 4 metres executed in an alloy of platinum and iridium. The specific gravity of the alloy is 21·508, and its composition is found to be:—

Platinum	89·40	89·42
Iridium	10·16	10·22
Rhodium	0·18	0·16
Ruthenium	0·10	0·10
Iron	0·06	0·06
	99·90	99·96

The remarks of MM. Sainte-Claire Deville and Dumas are decidedly complimentary; those of M. Tresca somewhat ungracious.

New Method of Studying the Thermic Spectra.—M. Aymonnet.—The study of the thermic spectra of absorption with bodies raised to different temperatures may and should lead to a knowledge of the physical laws connecting the phenomena of the association and dissociation of bodies to the thermic and luminous phenomena.

Production of Carbonate of Soda by the Action of Chloride of Sodium in Solution upon the Carbonates of Lime and Magnesia in Presence of Vegetable Matter.—M. P. Pichard.—The author concludes from his experiments and observations that—(1) Carbonate of soda and calcic and magnesic chlorides often coexist in briny and gypsiferous waters which have remained in calcareous and dolomitic soils. (2) The carbonate of soda appears to be formed by the reaction of sodic chloride upon calcic and magnesic carbonates in presence of organic matter. (3) This reaction is, in fact, produced if we leave in contact in a dark place common salt, green leaves, water charged with carbonic acid, and a large excess of limestone. It is not produced in the absence of organic matter. (4) The presence of sulphate of lime is not necessary, and seems rather to produce a diminution of the effect. (5) The production of carbonate of soda under these conditions is accompanied by the formation of ammonia, but in a less quantity in waters charged with sulphate of lime.

No, 24, December 11, 1876.

Composition of Glass and Crystal among the Ancients.—M. E. Peligot.—The author is of opinion that the common glass and the plumbiferous crystal had formerly a composition which differed strikingly from that of corresponding modern products. Modern glass contains lime along with the alkali and silica. In ancient specimens lime is only found in a much smaller proportion. The crystal glass of antiquity was a silicate of lead without alkali.

General Method of Analysis for the Tissues of Vegetables.—M. E. Fremy.—The study of *organic substances*, so successfully pursued at present by a great num-

ber of chemists, should not cause us to overlook that of *organised bodies*, which are overlooked in these days, and which nevertheless are of great interest as revealing the compounds which are indispensable to the performance of the vital functions. The proximate analysis of vegetable tissues presents a difficulty which all chemists will understand, its object being to determine the composition of a structure formed of insoluble elements in neutral solvents. The principal tissues of plants, after exhaustion by neutral solvents, are formed by the organic association of the following bodies:—Cellulosic substances (cellulose, meta-cellulose, para-cellulose), vasculose, cutose, pectose, pectate of lime, nitrogenous compounds, and various mineral matters. Dilute cold hydrochloric acid decomposes the pectate of lime, and sets at liberty the pectic acid, which is then easily determined by means of alkalies. Dilute boiling hydrochloric acid transforms pectose into pectin, which is precipitated by means of alcohol. Ammoniacal cupric reagent dissolves the cellulose. Boiling hydrochloric acid renders para-cellulose soluble in the ammoniacal cupric reagent. Bihydrated sulphuric acid dissolves the cellulosic substances. Dilute and boiling potassa dissolves cutose. Potassa under pressure effects the solution of vasculose. Dilute nitric acid renders vasculose soluble in alkaline solution.

Polymer of the Oxide of Ethylen.—M. A. Wurtz.—Oxide of ethylen, which had been prepared in the summer of 1874, and left in a sealed tube, was found in about a year converted into a dry, solid, white crystalline body, melting at 56°.

Disengagement of Ammonia observed on the Rupture of Certain Bars of Steel.—M. Barré.—This phenomenon has been repeatedly observed at the works of Anina. Hard steel gave off a quantity of ammonia sufficiently strong to be perceived at some distance. Red litmus paper and turmeric paper on being applied to the fracture immediately changed their colour, the former to blue and the second to brown. If the broken surface was moistened bubbles of gas were seen escaping for a quarter of an hour. With softer steel the escape of ammonia was less manifest, but was nevertheless detected by means of test-paper, These observations refer to steel made in the gas-furnace by the Siemens' process, but the same phenomenon has also been recognised with Bessemer steel.

Les Mondes, Revue Hebdomadaire des Sciences, November 23, 1876.

A complimentary banquet in honour of M. Chevreul is about to be given by the Academy of Sciences on the 50th anniversary of his membership.

Under the heading "Unconscious Cerebration," there is an attack made upon certain members of the Anthropological Society of Paris for having promised to bequeath their brains to the Society for examination and dissection.

A peculiar phase of madness occurring among French cooks, and known as *folie des cuisiniers*, is due to the carbonic oxide given off by the charcoal stoves so largely employed in culinary operations. It is characterised by hallucinations of sight and hearing, vertigo, oppression, and syncope. The patient generally believes himself the victim of persecution.

Oenokrine is the name of a test-paper sold in Paris for the purpose of detecting the fraudulent colouration of wines. With a genuine red wine the colour produced is a greyish blue, which becomes lead-coloured on drying. With magenta and other aniline colours it turns a carmine red; with ammoniacal cochineal, a pale violet; with elder berries, the petals of roses, &c., a green; with logwood and Brazil wood, the colour of dregs of wine; with Fernambucca wood and phytolacca, a dirty yellow; with extract of indigo a deep blue. The manipulation required is very simple. A slip of the paper is steeped in pure wine for about five seconds, briskly shaken in order to remove the excess of liquid, and then placed on a sheet of white paper to serve as a standard. A second slip of the test-paper is then steeped in the suspected wine in the same manner and laid beside the former. It is asserted that 1-100,000th of magenta is sufficient to give the paper a violet shade, whilst a larger quantity produces a carmine red. The inventors of the test-paper, MM. Lainville and Roy, are also said to have discovered a method of removing magenta from wines without injuring their quality, a fact of some importance if it be true that several hundred thousand hectolitres of wine sophisticated with magenta are in the hands of merchants.

Analysis of the Gases of the Grotto del Cane.—M. Et. Finot.—Two analyses of gases taken in this cavern, and preserved in bottles hermetically sealed, gave the following results:—

Carbonic acid	25·38	25·69
Oxygen	18·46	20·13
Nitrogen	56·16	54·18
	100·00	100·00

Deducting the carbonic acid, the residual air has the composition:—

Oxygen	24·74	27·10
Nitrogen	75·26	72·90
	100·00	100·00

a larger proportion of oxygen than is found in common air.

Heating Rooms by the New Cheminées Caloriferes of M. Bolo de Sevray.—The arrangement of these stoves cannot be made intelligible without the aid of diagrams. It is said that of the 4000 calories produced by the combustion of 1 kilogramme of wood, from 200 to 300 at most are utilised in a common fire, the rest escaping without doing any service. The new *Cheminée calorifère* utilises 2500 to 2800 calories.

November 30, 1876.

In an article headed "Anti-Religious Hatred of Free-thinking Science," it is asserted that "Recamier performed 40 years ago, and on a larger scale, a great number of the experiments of Mr. Crookes on the impulsive force of light and heat, and set up in his cabinet a colossal radiometer.

A fresh attack is made on the French physicians and men of science who have agreed to bequeath their bodies for dissection.

New Radiometric Experiments.—M. Collado.—The author has exposed a sensitive radiometer to the light of the full moon, and concentrated the light upon the blackened surfaces of the discs by means of lenses or of concave mirrors, but without perceiving any movement. In like manner, if a radiometer is submitted to the radiation of a single Bunsen burner the speed of the revolution is not altered if the pale blue flame is rendered luminous.

Influence of Different Colours upon Vegetation.—M. Paul Bert.—The author has undertaken some new experiments upon the influence of different colours upon vegetation. These experiments, performed chiefly upon the sensitive plant, lead to the following results:—Green light kills plants; plants submitted to the influence of the green ray die in a short time. Under the influence of the red rays the sprays become elongated; the leaflets are raised so as to form a smaller angle with the branch than in the normal state, the plant appears to become etiolated and yet it remains alive. Under the influence of the blue rays the process is reversed, the leaflets become perpendicular to the branch, whilst in white light an intermediate position is maintained (*i.e.*, the leaflets form with the branch an angle of 45° on one side and of 75° on the other. M. Bert explains these facts as follows:—At the

level of the point of attachment of the leaflet there is a motor enlargement, which increases or lessens in force according to the different kinds of rays. Under the influence of the red rays there is formed in these enlargements a particular substance, osmotic, and capable of attracting water. This substance generally disappears under the influence of the blue rays. If we place it under a glass shade, red on one side, and green on the other, the plant turns its leaflets towards the green, that is to say, towards the colour which kills it, and in fact it dies.

Reimann's Farber Zeitung.
Nos. 40 and 41, 1876.

These issues contain nothing of general interest or importance.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

DECEMBER, 1876.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·003	0·009	0·165	0·128	20·76	7·670	0·540	0·94	2·130	13·2	3·8
West Middlesex	Slightly turbid	0·006	0·009	0·165	0·100	22·61	8·960	0·540	0·94	2·130	14·3	4·6
Southwark and Vauxhall	Slightly turbid	0·002	0·008	0·150	0·114	21·14	8·120	0 540	0·94	2·060	14·3	4·6
Chelsea	Slightly turbid	0·006	0·010	0·135	0·132	19·18	7·110	0·500	0·94	2·400	12·1	4·6
Lambeth	Slightly turbid	0·001	0·007	0·150	0·110	19·48	7·390	0·570	1·01	2·600	12·7	4·6
Other Companies.												
Kent	Clear	0·000	0·002	0·216	0·007	26·73	10·020	1·000	1·37	3·000	19·4	5·1
New River	Clear	0·000	0·004	0·160	0·092	19·28	7·440	1·460	0·86	1·730	14·3	4·2
East London	Slightly turbid	0·002	0·006	0·135	0·052	23·21	9·200	0·610	1·15	2·460	15·4	3·4

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

MEETINGS FOR THE WEEK.

MONDAY, Jan 15th.—London Institution, 5.
—— Medical, 8.
TUESDAY, 16th.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Zoological, 8.30.
WEDNESDAY, 17th.—Society of Arts, 8.
—— Meteorological, 7. Annual General Meeting.
THURSDAY, 18th.—Royal, 8.30.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Chemical, 8. "Preliminary Account of some New Reactions in Organic Chemistry and their Ultimate Bearings," by C. T. Kingzett and H. W. Hake. "On Kekulé's and Ladenburg's Benzene Symbols," by H. E. Armstrong. "On Nitroso-orcin," by J. Stenhouse and C. E. Groves.
—— London Institution, 7.
—— Zoological, 4.
FRIDAY, 19th.—Royal Institution. Weekly Meeting, 8. Professor Tyndall, "A Combat with an Infective Atmosphere," 9.
SATURDAY, 20th.—Royal Institution, 3. Mr. Ernst. Pauer, "On the Nature of Music: the Italian, French, and German Schools (with Pianoforte Illustrations).
—— Physical, 3. "On the Photographic Spectra of Stars," by W. Huggins, D.C.L., F.R.S. "On the Artificial Production of Columnar Structure," by W. Chandler Roberts, F.R.S.

TO CORRESPONDENTS.

E. F. George.—The specific gravity, hardness, crystalline form, and optical properties will be sufficient to identify most transparent mineral crystals.

F. Faulkner.—Messrs. Asher and Co., of Bedford Street, Covent Garden, can perhaps procure a copy for you.

ROYAL INSTITUTION OF GREAT BRITAIN, ALBEMARLE STREET, PICCADILLY, W.

DR. C. R. ALDER WRIGHT, will, on THURSDAY NEXT, JANUARY 18, at Three o'clock, begin a Course of Four Lectures "On Metals, and the Chief Industrial Uses of these Bodies and their Compounds." Subscription to this Course, Half-a-Guinea: to all the Courses in the Season, Two Guineas.

ROYAL SCHOOL OF MINES.—Dr. FRANKLAND, D.C.L., F.R.S., will commence a Course of Thirty Lectures on "Organic Chemistry," at South Kensington, on MONDAY NEXT, the 15th JANUARY, at 10 o'clock, to be continued on each succeeding Wednesday, Friday, and Monday at the same hour. Fee, £3; to those who have attended the previous Course £2.

TRENHAM REEKS, Registrar.

THE TEXTILE COLOURIST: Edited by CHARLES O'NEILL, F.C.S.

Price 2s. 6d. Monthly.

CONTENTS OF No. XIII.—JANUARY, 1877.

Introduction—Materials for a History of Textile Colouring, No. 4 (continued)—Programme of Prizes offered by the Industrial Society of Mulhouse for the Year 1877—Upon the Greening of Aniline-Black—Keechlin Fréres Process for Preventing the Greening of Aniline-Black—M. Camille Koechlin upon the Greening of Aniline-Black—Experiments upon the Application of Anthra-violet, by M. N. Potier—Nitro-alizarin and Amidalizarin—M. Michel de Vinant on Dyeing, Printing, and Bleaching—New Book: A Treatise upon Washing Machines employed in Bleaching and Calico Printing, by Jos. Dépierre—Abridgments of Complete Specifications of Patents Recently Published—British and Foreign Patents, from the Commissioners of Patents Journal, October 27th to December 19th, 1 76, inclusive—Diagram: Firth's Improvements in Indigo Dyeing—Diagram: Mather's Improvements in Steaming—Supplement: The Practice and Principles of Calico Printing, Bleaching, Dyeing, &c., by Charles O'Neill, F.C.S.—Fixing of Mordants—Dyeing Apparatus (continued).

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THE CHEMICAL NEWS

VOL. XXXV. No. 895.

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

(Continued from p. 17.)

Part III.—BLEACHING-POWDER.

IT was in the year 1785 that Berthollet discovered the bleaching action of chlorine; he showed the experiments to Watt in 1786, and he on his return to Glasgow actually bleached a considerable quantity of linen by means of a solution of chlorine in water.

In the following year a work was established in Aberdeen by Professor Copeland and the then Duke of Gordon, for the production of solution of chlorine, which they supplied to the neighbouring bleachers.

The injurious effects of the chlorine both on the workmen and on the goods caused the introduction of a portion of potash to the water, which had the effect of retaining the chlorine.

This method was extensively adopted by bleachers all over the country; the solution, however, did not keep well.

In 1798, Mr. Charles Tennant (then engaged in bleaching operations at Darnley) patented the use of lime instead of potash, and in conjunction with Mr. M'Intosh and others began the manufacture of "lime bleaching liquor." They also granted licenses to bleachers, giving the right to manufacture it for themselves. The method was most successful, but the patent was disputed and declared untenable.

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* Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

level of the point of attachment of the leaflet there is a motor enlargement, which increases or lessens in force according to the different kinds of rays. Under the influence of the red rays there is formed in these enlargements a particular substance, osmotic, and capable of attracting water. This substance generally disappears under the influence of the blue rays. If we place it under a glass shade, red on one side, and green on the other, the plant turns its leaflets towards the green, that is to say, towards the colour which kills it, and in fact it dies.

Reimann's Farber Zeitung.
Nos. 40 and 41, 1876.

These issues contain nothing of general interest or importance.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

DECEMBER, 1876.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·003	0·009	0·165	0·128	20·76	7·670	0·540	0·94	2·130	13·2	3·8
West Middlesex	Slightly turbid	0·006	0·009	0·165	0·100	22·61	8·960	0·540	0·94	2·130	14·3	4·6
Southwark and Vauxhall	Slightly turbid	0·002	0·008	0·150	0·114	21·14	8·120	0 540	0·94	2·060	14·3	4·6
Chelsea	Slightly turbid	0·006	0·010	0·135	0·132	19·18	7·110	0·500	0·94	2·400	12·1	4·6
Lambeth	Slightly turbid	0·001	0·007	0·150	0·110	19·48	7·390	0·570	1·01	2·600	12·7	4·6
Other Companies.												
Kent	Clear	0·000	0·002	0·216	0·007	26·73	10·020	1·000	1·37	3·000	19·4	5·1
New River	Clear	0·000	0·004	0·160	0·092	19·28	7·440	1·460	0·86	1 730	14·3	4·2
East London	Slightly turbid	0·002	0·006	0·135	0·052	23·21	9·200	0·610	1·15	2·460	15·4	3·4

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

MEETINGS FOR THE WEEK.

MONDAY, Jan 15th.—London Institution, 5.
—— Medical, 8.
TUESDAY, 16th.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Zoological, 8.30.
WEDNESDAY, 17th.—Society of Arts, 8.
—— Meteorological, 7. Annual General Meeting.
THURSDAY, 18th.—Royal, 8.30.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Chemical, 8. "Preliminary Account of some New Reactions in Organic Chemistry and their Ultimate Bearings," by C. T. Kingzett and H. W. Hake. "On Kekulé's and Ladenburg's Benzene Symbols," by H. E. Armstrong. "On Nitroso-orcin," by J. Stenhouse and C. E. Groves.
—— London Institution, 7.
—— Zoological, 4.
FRIDAY, 19th.—Royal Institution. Weekly Meeting, 8. Professor Tyndall, "A Combat with an Infective Atmosphere," 9.
SATURDAY, 20th.—Royal Institution, 3. Mr. Ernst. Pauer, "On the Nature of Music: the Italian, French, and German Schools (with Pianoforte Illustrations).
—— Physical, 3. "On the Photographic Spectra of Stars," by W. Huggins, D.C.L., F.R.S. "On the Artificial Production of Columnar Structure," by W. Chandler Roberts, F.R.S.

TO CORRESPONDENTS.

E. F. George.—The specific gravity, hardness, crystalline form, and optical properties will be sufficient to identify most transparent mineral crystals.

F. Faulkner.—Messrs. Asher and Co., of Bedford Street, Covent Garden, can perhaps procure a copy for you.

ROYAL INSTITUTION OF GREAT BRITAIN, ALBEMARLE STREET, PICCADILLY, W.

DR. C. R. ALDER WRIGHT, will, on THURSDAY NEXT, JANUARY 18, at Three o'clock, begin a Course of Four Lectures "On Metals, and the Chief Industrial Uses of these Bodies and their Compounds." Subscription to this Course, Half-a-Guinea: to all the Courses in the Season, Two Guineas.

ROYAL SCHOOL OF MINES.—Dr. FRANKLAND, D.C.L., F.R.S., will commence a Course of Thirty Lectures on "Organic Chemistry," at South Kensington, on MONDAY NEXT, the 15th JANUARY, at 10 o'clock, to be continued on each succeeding Wednesday, Friday, and Monday at the same hour. Fee, £3; to those who have attended the previous Course £2.

TRENHAM REEKS, Registrar.

THE TEXTILE COLOURIST: Edited by CHARLES O'NEILL, F.C.S.

Price 2s. 6d. Monthly.

CONTENTS OF No. XIII.—JANUARY, 1877.

Introduction—Materials for a History of Textile Colouring, No. 4 (continued)—Programme of Prizes offered by the Industrial Society of Mulhouse for the Year 1877—Upon the Greening of Aniline-Black—Koechlin Frères Process for Preventing the Greening of Aniline-Black—M. Camille Koechlin upon the Greening of Aniline-Black—Experiments upon the Application of Anthra-violet, by M. N. Potier—Nitro-alizarin and Amidalizarin—M. Michel de Vinant on Dyeing, Printing, and Bleaching—New Book: A Treatise upon Washing Machines employed in Bleaching and Calico Printing, by Jos. Dépierre—Abridgments of Complete Specifications of Patents Recently Published—British and Foreign Patents, from the Commissioners of Patents Journal, October 27th to December 19th, 1 76, inclusive—Diagram: Firth's Improvements in Indigo Dyeing—Diagram: Mather's Improvements in Steaming—Supplement: The Practice and Principles of Calico Printing, Bleaching, Dyeing, &c., by Charles O'Neill, F.C.S.—Fixing of Mordants—Dyeing Apparatus (continued).

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THE CHEMICAL NEWS

VOL. XXXV. No. 895.

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

(Continued from p. 17.)

Part III.—BLEACHING-POWDER.

IT was in the year 1785 that Berthollet discovered the bleaching action of chlorine; he showed the experiments to Watt in 1786, and he on his return to Glasgow actually bleached a considerable quantity of linen by means of a solution of chlorine in water.

In the following year a work was established in Aberdeen by Professor Copeland and the then Duke of Gordon, for the production of solution of chlorine, which they supplied to the neighbouring bleachers.

The injurious effects of the chlorine both on the workmen and on the goods caused the introduction of a portion of potash to the water, which had the effect of retaining the chlorine.

This method was extensively adopted by bleachers all over the country; the solution, however, did not keep well.

In 1798, Mr. Charles Tennant (then engaged in bleaching operations at Darnley) patented the use of lime instead of potash, and in conjunction with Mr. M'Intosh and others began the manufacture of "lime bleaching liquor." They also granted licenses to bleachers, giving the right to manufacture it for themselves. The method was most successful, but the patent was disputed and declared untenable.

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* Read before the Chemical Section of the British Association, Glasgow Meeting, 1876.

The use of the still liquors from the chlorine manufacture early attracted attention.

These consisted chiefly of sulphates of soda and manganese, and were at first worked up into Glauber's salt, and the manganese seems to have been recovered to some slight extent.

In the year 1800 Lord Dundas had a work for the manufacture of mineral alkali in operation at Dalmuir.

The works were of considerable size for that period, as the following table will show, being a statement of the working for years 1801 to 1804:—

View of Mineral Alkali Works.

Year.	Alkali Sold. T. C. Q. Lbs.	Price per Ton.	Black-Ashes Sold. T. C.	Price per Ton.
1801	25 12 2 24	£49·5	112 15	£10·0
1802	62 11 0 21	47·9	31 5	12·2
1803	46 16 1 2	41·2	—	—
1804	128 16 2 6	37·0	—	—
	263 16 2 5	£42·0	144 0	£10·56

Year.	Barilla Sold. T. C. Q. Lbs.	Price per Ton.	Muriate of Potass Sold. T. C.	Price per Ton.
1801	5 0 3 23	£15·0	54 10	£13·00
1802	14 6 0 0	20·2	122 0	13·24
1803	23 17 1 25	20·0	121 10	13·00
1804	21 6 3 0	20·9	90 0	6·50
	64 11 0 20	£20·23	388 0	£10·56

From the fact that soap leys and the salt obtained from them were purchased in large quantity from the soap makers, it is probable that the process was substantially the same as that described as follows, in November, 1806:—

"At Dalmuir they prepared from soap leys got from Paisley and elsewhere, 150 tons salts, and from these 120 tons crystals of soda and 21 tons muriate of potass.

"The manufacture employed 15 workmen, and consumed 1200 tons of coal, at 10s. per ton, delivered at the works, and used 200 barrels potass at 10s.

"Sal-e-nixon (sulphate of potass) and sulphur ashes (chiefly sulphate of potass), from nitre used in the vitriol manufacture.

"When potass is used, it is added to the mother-liquors of the first crystallisation of soda, never put into the furnace with the soap salts.

"When sal-e-nixon or sulphur ashes are used, the first is put into the furnace with the salts, sawdust, and a little quicklime; the second is first lixiviated.

"Their furnace yields 12 cwts. of flux per charge, and requires six hours to flux it. They do two charges in twelve hours, but do not work at night, it being found a preservation of the furnace to allow it to cool during the night.

"The furnace is shut up when the charge is put in, and is never stirred during the operation.

"Soda and muriate of potass are crystallised out alternately.

"The muriate of potass is never raked out over the hot solution of the salts. The carbonate of soda is found to fall with the muriate when the evaporation is continued until the salts begin to form.

"They do not know whether the decomposition of the muriate of soda with the sulphate takes place in the furnace or in the subsequent process of evaporation.

"The mother-liquors are heated with sawdust in order to make them crystallise, that is, to carbonate them.

"The soda is seldom ever crystallised twice, particular attention being paid to having the solution pure.

"The liquors are sometimes filtered.

"The soapers' leys are evaporated in iron vessels, say circular vessels of the usual form, in one piece, and yielding 8 cwts. salts per day. They contain about 500 galls. each.

"The lead coolers are 9 ft. long by 4½ ft. broad, and 10 ins. deep.

"The lead boilers are nearly of the same dimensions, but 15 ins. deep.

"They say they have found a substitute for potass in decomposing the muriate of soda, which works equally well and does not cost 20s. per ton.

"The crystals are seldom ever free from muriate of potass, even when the crystallisation is pretty perfect in form.

"The muriate of potass, on the other hand, is seldom ever free from alkali.

"When the potass is redundant in the liquors, they will not crystallise.

After the muriate of potass is crystallised, the mother-liquor is carbonated, and soda crystallised from it.

"*Charges on One Ton of Soda.*

"1·25 tons soap salts, at £6 10s. ..	£8 2 6
"0·15 " potass, at £60..	9 0 0
" 4 " coals, at 10s.	2 0 0
"40 bags sawdust, at 4d.	0 13 4
"Wages	5 0 0
"Incidents	1 0 0
"Tear and wear	3 0 0
"Interest	2 10 0
	"£31 5 10"
In all	£31 5 10
By 3 cwt. muriate of potass, at 13s.	1 19 0
Nett cost of 1 ton of crystals of soda ..	£29 6 10

Selling price, about £60.

The yearly statement shows the make to have been 120 tons, and the cost £32 per ton.

By another method in use about the same period, a mixture of 10 cwts. of soapers' salts, 6 cwts. of sawdust, and 3 cwts. of lime, was heated for six hours in a furnace until fluxed; it was then run off, and when cold, broken into small pieces and lixiviated in large vessels holding as much as 10 tons at a time, on a filter bottom of gravel and sand placed on coarse canvas. This filter lasted two to three months.

The liquor from this black-ash deposited a considerable quantity of muriate of potass.

The remaining liquor was evaporated slowly without boiling till a pellicle formed, and then run off to crystallise.

To the mother-liquors, from this crystallisation, 3 cwts. or so of potash in solution (according to quality of liquor) is added, the liquid again concentrated and crystallised, this being the third crop of muriate of potash crystals.

The mother-liquor from this was called barilla-liquor; it was boiled down to dryness, the salts mixed with their own weight of sawdust, and carefully roasted till the sawdust was consumed, never being allowed to flux.

Another method of carbonating was to make the salts red-hot, and then mix them as quickly as possible with powdered charcoal.

This carbonated alkali was then lixiviated with cold water, evaporated till a pellicle formed, and after settling for about twelve hours, run into coolers to crystallise.

This soda was re-crystallised.

"In preparing barilla salts for bleachers" (this wa actually what is now called soda-ash) "the colour may regulated by the use of nitre—if a white is desired, greater quantity; if a blue, a lesser will suffice.

"A note of the production of soda from kelp show that from—

"100·00 kelp,
" 2·72 charcoal,
" 7·29 potass (crude),
"200·00 coals,

"there should be obtained—

"74·3 soda crystals,
"28·4 muriate of potass,
"33·0 sulphate of potass."

The methods which were adopted at the St. Rollox Works were very various as fresh light was thrown on the science of chemistry.

Almost immediately after the commencement of bleaching-powder manufacture, the waste products of the stills were utilised for the production of alkali for soap making.

These residues, consisting chiefly of sulphate of soda and manganese, with varying quantities of common salt and sulphuric acid in the free state, were in the first case used in the manufacture of Glauber's salts; this was followed by a method of making sal-ammoniac from urine collected in Glasgow in casks.*

This process was found unsuitable, probably from the difficulty of obtaining ammonia in sufficient quantity, and was soon displaced (in 1803) by a process, or rather a sequence of processes, which, with slight variations, continued in use for many years, until the introduction of the complete Leblanc system of alkali making.

This was the production of a crude alkali or black-ash for use in soap making instead of kelp, then usually employed.

The earliest details which I have been able to find show that the still residuums were run into wooden tubs, where they were mixed with ground coal or sawdust till in a thick pasty state: this mass was then transferred to a reverberatory furnace and melted. When the decomposition had ceased it was run out, and when cold, broken up and lixiviated with caustic lime, and the caustic leys thus formed were used in the saponification of the fatty matters.

This was followed by a method of mixing the liquor obtained by lixiviating the above black-ash with sawdust, and again furnacing, when a barilla was obtained worth at that time about £28 per ton.

Cost of One Ton Barilla from Residuum.

6 cwts. salts, at 5s.	£1	10	0
5 „ lime, at 1s.	0	5	0
40 „ coal, 7s. 6d.	0	15	0
Labour	0	6	0
Tear and wear	0	2	0
Yielding 1 ton barilla, costing ..	£2	18	0

And containing 3 to 10 per cent alkali, worth then about £10 per ton.

The soap leys, after having become spent, were boiled down to salts, and barilla again made from them, much on the system already described as in use at Dalmuir.

Cost of One Ton Barilla from Soaper's Salts.

14 cwts. of soapers' salts, at 5s. ..	£3	10	0
3 „ lime, at 1s.	0	3	0
20 „ coal, at 7s. 6d.	0	7	6
Labour	0	4	0
Tear and wear	0	1	4
	£4	5	10
By 10 cwts. of muriate of potash, at 5s.	2	10	0
1 ton of barilla of 7 p.c. alkali, costing	£1	15	10

At first the muriate of potash was employed in the stills instead of common salt, but this was soon given up, and the muriate of potash was sold, chiefly to the alum makers of the district.

The manufacture of vitriol gave as a by-product a considerable quantity of "sulphur ash" residues, consisting of sulphate of potash, mixed with a little unburnt sulphur. This was used along with soapers' salts, and gave a larger yield of muriate of potash.

The mixture employed seems to have been at this time—

280 lbs. soapers' salts.
112 „ sulphur ashes.
84 „ lime.
112 „ coal.

588 „ in all.

Yielding 364 lbs. black-ash, containing 10·5 per cent alkali, and 25 per cent insoluble.

In 1806 a trial was made of the mother-liquors from the alum works as a source of potash; the black-ash made from a mixture of this liquor and soapers' salts gave only about 6 per cent alkali, and from this and other causes its use was soon abandoned.

"A statement of the products obtained at this time from 100 parts of salt is subjoined:—

"100 parts salt,
" 83 „ oil of vitriol,
" 56 „ manganese,

"produced bleaching-powder. The residue from above, with 150 parts American potash of 81 per cent., "produces—

"265 parts soda crystals.
" 160 „ sulphate of potash.
" 50 „ of manganese recovered.

"It will therefore produce as much soap as 16 cwts. of kelp, even reckoning kelp as containing above 3 per cent of real soda, worth 10s. per cwt."

Methods more or less of this nature continued to be used until about 1816, when a good deal of correspondence with the French manufacturers, Chaptal and D'Arcet, took place, relative to the Leblanc system, which was finally adopted in 1818.

The following extract from the correspondence is of considerable interest, under date July, 1816. Messrs. C. and D'A. say, in reference to their manufacture of soda:—

"They produced 44,000 lbs. per day of crude soda (black-ash), containing 20 to 21 per cent alkali, which they sell at 20 francs per quintal (equal to 16s. 8d.).

"It is produced from common salt obtained from the spontaneous evaporation of the sea-water at Marseilles, and costs about 9d. to 10d. per quintal. It is decomposed by sulphuric acid in the proportion of 83 acid to 100 salt.

"In purifying their crude soda, and crystallising, they always experience a loss of nearly 25 per cent of the alkali, indicated by the acid test in the crude soda."

These gentlemen utilised to some extent the muriatic acid evolved, by producing gelatine from bones, for the manufacture of soup, of which M. D'Arcet says he had made 1,300,000 portions of a quart each.

In 1818 these gentlemen had the intention to "establish works in Liege and in London, for making soda, nitric acid, marine acid, gelatine, &c."

In this year a process was at work at Port-Dundas for preparing a black-ash for soap-making purposes, and this is the first record of the use of carbonate of lime (previously caustic lime seems to have been always used).

The mixture used was:—

10 parts soapers' salts.
2½ „ poor kelp.
2½ „ chalk.
5 „ sawdust.

This was fluxed for six hours, and gave a black-ash testing 6 to 7 per cent alkali.

In the end of this year, French soda was imported into London. It was in the form of black-ash, and of three qualities.

No. 1, containing 13 per cent alkali, sold at £30 per ton.
„ 2, „ 12 „ „ „ 26 „
„ 3, „ 11 „ „ „ 25 „

It was manufactured at Marseilles by the Leblanc process, which had been fully established there for some years. Three qualities of soda were made for sale.

* The obtaining ammonia from urine has been tried at various times in Glasgow, and at present Mr. G. Chapman works a process which is believed to be very successful.

1. Crude soda (now called black-ash).
2. Crystals obtained by the lixiviation of the crude soda.
3. Calcined residues from the "bitter water" (now called soda-ash).

All these qualities had certainly been produced since the year 1807, works being in operation at Marseilles, Chauny, Rouen, Lille, Amiens, and elsewhere.

The first sale of soda made at St. Rollox on the Leblanc system, took place in the end of 1818. It was sold at £42 per ton. Carbonate of soda, or soda-ash, had been made for some months previously, but was apparently all consumed in the manufacture of soap.

The use of soapers' salts was still continued, and black-ash was made for sale from the following mixture:—

1	cwt.	Irish kelp.
1¼	,,	soap salts.
1	,,	sulphur ashes.
1½	,,	chalk.
1⅛	,,	coals.
In all, 6¼	,,	

Yielding 3 cwts., 2 qrs., 14 lbs. black-ash, containing 14 per cent alkali.

In the following years soda crystals were sold in constantly increasing qualities.

Table of Prices Realised.

Year.	Price Per Ton.
1818	£42 0 0
1819	41 0 0
1820	40 0 0
1824	27 0 0
1829	15 0 0
1834	12 0 0
1839	11 0 0
1844	6 0 0
1849	5 10 0
1154	4 10 0
1859	6 0 0
1864	4 15 0
1869	4 5 0
1874	5 10 0

The quantity made has rapidly increased from about 100 tons in 1818, to 1400 tons in 1829, and is now nearly 14,000 tons per annum.

Carbonate of potash was made in considerable quantities from about 1820.

It was produced from the sulphate of potash (obtained as a by-product in the manufacture of sulphuric acid) by the Leblanc system. The price in 1820 was £15 per ton. On the introduction of nitrate of soda as a substitute for nitrate of potash, this manufacture was given up at St. Rollox; but it has revived again in the district within the last few years, considerable quantities being now manufactured, chiefly for their own use, by the bichromate and prussiate of potash manufacturers.

Soda-ash, so-called, was first sold from these works in 1833, when it rapidly took the place of black-ash, previously sold. In 1833 only 19 tons of soda-ash were sold, at a price of £22 per ton; in 1865 the quantity had increased to 12,500 tons, sold at £9 per ton.

The sulphate of soda required for the manufacture on the Leblanc system was at first prepared at these works in iron cylinders (such as are yet usually employed in the manufacture of nitric acid), and the muriatic acid evolved was condensed in upright earthenware condensers.

In 1822, pots of some form were introduced, the charge of salt weighing 4½ cwts., and yielding 560 lbs. muriatic acid of 40°.

Various improvements were introduced from time to time; amongst others, Gamble's improved furnace for salt-cake making; Gossage's condensing towers; the circulating system of vats for lixiviating black-ash, first adopted at these works, and introduced by Mr. C. T. Dunlop.

The revolving black-ash furnace of Elliott and Russell was tried at St. Rollox soon after its invention, but failed at that time to give satisfaction, the furnace at that time being too small and imperfect to compete with hand labour at the low rates then paid.

It was much improved by Messrs. Stevenson and Williamson, of the Jarrow Works, both in construction and in the method of working it, and became in their hands quite a success.

This form of furnace was again introduced at the St. Rollox Works, where there are now three furnaces.

These are worked on a system, patented by the writer, which has been eminently successful. It has increased the producing power of the furnaces over 50 per cent, with a large saving of raw material, and a corresponding diminution in the quantity of waste produced. The amount of alkali usually lost in the waste being proportionately reduced.

This system is now employed in a number of the largest alkali works in England, and it is expected will shortly be at work in France.

The form of the furnace has at the same time been much improved; and while the first furnace erected at Jarrow was capable of working somewhere about 8 tons sulphate of soda per twenty-four hours, the most recent of those erected at St. Rollox decomposes 50 tons in the same time.

The three revolving furnaces easily decompose 720 tons sulphate of soda per week of six days.

The most recent improvement introduced is a mechanical furnace for calcining or carbonating the soda-ash. This has only been at work for a short time, but promises to be quite as successful as the black-ash furnaces have been.

Other works in Glasgow and the district have been erected at various times for the manufacture of alkali, of which there are at present existing as alkali works, so far as I can ascertain, only four, viz.:—

Messrs. R. and J. Garroway, Glasgow.
,, Orr and Brown, Irvine.
,, W. Henderson and Co., Irvine.
,, Arnott, Bros., and Co., Kirkintilloch.

To be continued.)

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, Ph.D.,
Professor in University College, Toronto.

(Continued from page 14).

V. *On the Solubility of Bismuth Oxide in Carbonate of Soda before the Blowpipe.*

Neither in the treatise of Berzelius, nor in the more modern and advanced work of Plattner, is any reference made to the behaviour of oxide of bismuth with carbonate of soda in an oxidating flame. In Plattner's "Tabellarische Uebersicht des Verhaltens der Alkalien, Erden, und Metalloxyde für sich und mit Reagentien im Löthrohrfeuer," whilst oxide of lead is stated, correctly, to be soluble in carbonate of soda in an oxidating flame, the reference to oxide of bismuth is, simply, that with carbonate of soda on charcoal it becomes immediately reduced to metallic bismuth; and none of his translators seem to have thought it necessary to supply the omission. In Hartmann's tabular "Untersuchungen mit dem Löthrohr," in the handy little work of Bruno Kerl ("Leitfaden bei qualitativen und quantitativen Löthrohr-Uutersuchungen"), in the "Löthrohr-Tabellen" of Hirschwald, and all other blowpipe books that I have met with, the same singular omission occurs. This seems to bear out very forcibly the somewhat cynical adage that "books are made from books." To supply the omission, it may be observed that

* Communicated by the Author.

bismuth oxide dissolves in carbonate of soda very readily in an oxidating flame if the supporting agent be platinum wire or other non-reducing body. The glass is clear yellow whilst hot, but on cooling it assumes an orange or yellowish brown colour, and becomes pale yellow and opaque when cold. As regards their solubility by fusion in carbonate of soda, metallic oxides fall into three groups—(1) Easily soluble, *e.g.*, PbO, Bi_2O_3, BaO, &c.; (2) Slightly or partially soluble, *e.g.*, Mn_2O_3, CoO, &c.; and (3) Insoluble, *e.g.*, Fe_2O_3, Ce_2O_3, NiO, CaO, MgO, &c.

VI. *On the Detection of Bromine in Blowpipe Experiments.*

When fused with phosphor salt and copper oxide the bromides, it is well known, impart an azure blue colouration to the flame, much like that produced by chlorides under similar treatment, although streaked more or less with green, especially at the commencement of the operation. To distinguish these bodies more closely Berzelius recommended the fusion of the test substance with 6 or 7 volumes of bisulphate of potash in a closed tube. Bromines by this treatment become decomposed, as a rule, and give off strongly-smelling brownish or yellowish red vapours of bromine. But this process does not always give satisfactory results, as in some instances the bromide is very slightly attacked. In this case, the following method, based on a peculiar reaction of bromide of silver, first pointed out by Plattner, may be resorted to. If insoluble the bromide is fused with 2 or 3 volumes of carbonate of soda. A soluble bromide of sodium is thus formed, with separation of the base. To the filtered or decanted solution of the fused mass a small fragment of nitrate of silver is added, in order to precipitate bromide of silver. This, collected by decantation, is fused with a small quantity of bisulphate of potash in a little flask or test-tube. The bromide of silver will quickly separate from the flux in the form of a blood-red globule, which becomes pale yellow when cold. The little globule, washed out of the tube by dissolving the fused bisulphate in some warm water, is carefully dried by being rubbed in a piece of blotting- or filtering-paper, and is then placed in the sunlight. After a short time it will turn green. Chloride of silver, as obtained in a similar manner, melts into an orange-red globule, which changes to clear yellow on cooling, and finally becomes white, or nearly so. Placed in sunlight it rapidly assumes a dark grey colour. Iodide of silver, under similar treatment, forms whilst hot an almost black globule, which becomes amethyst-red during cooling, and dingy yellow when cold. In the sunlight it retains the latter colour. A mixture of chloride and iodide of silver assumes a greenish tint, somewhat resembling the colour acquired by the bromide globule. This, however, can scarcely give rise to any error, as the presence of iodine is revealed—even if no violet coloured fumes be emitted—by the dark amethystine colour of the bead whilst hot.

VII. *On the Detection of Carbonates in Blowpipe Practice*

A mineral substance of non-metallic aspect, in nine cases out of ten, will be either a silicate, sulphate, phosphate, borate, carbonate, fluoride, or chloride; more especially if the streak be uncoloured, or merely exhibit some shade of green or blue, or if the substance evolve no fumes when heated on charcoal.

Simple fusion with phosphor salt on a loop of platinum wire serves at once to distinguish a silicate from any of the other bodies enumerated above, as, whilst the silicate is but slowly attacked, these other bodies are readily and rapidly dissolved. Among the latter, again, the carbonates are distinguished without risk of error by the marked effervescence which they produce in the bead by the evolution of carbonic acid during fusion—the phosphates, sulphates, &c., dissolving quietly. The reaction is quite as distinctive as that produced by the application of an ordinary acid; but, of course, it may arise in both cases not only from a carbonate proper, but from the presence of intermixed calcite or other carbonate in a silicate or other body. It was by its use, upwards of twenty years ago, that the writer detected the presence of carbonate of lime in certain specimens of Wernerite (the "Wilsonite" variety), portions of which had previously been analysed without the impurity having been discovered. It need scarcely be stated that the test substance must be added to the phosphor salt on the platinum loop only after the quiet fusion of the flux into a transparent glass. The reaction is, of course, manifested equally well with borax.

(To be continued.)

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 17).

TABLE II.—SCOTTISH CLAYBAND IRONSTONES.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.
Protoxide of Iron	47·31	39·60	34·98	37·23	32·20	24·90	37·54
Protoxide of Manganese	trace	1·52	0·82	1·96	1·64	1·22	3·60
Lime	0·97	1·79	1·66	5·17	5·74	16·55	6·50
Magnesia	0·91	3·96	2·08	4·17	4·08	7·54	0·43
Carbonic Acid	30·22	30·31	25·46	32·21	29·60	35·61	28·94
Phosphoric Acid	0·49	0·64	0·50	0·45	0·60	1·76	1·92
Sulphur	trace	0·08	0·11	0·28	0·51	0·31	0·27
Iron combined with Sulphur	—	0·07	0·10	0·25	0·45	0·27	0·24
Alumina	7·10	7·93	11·66	5·12	6·55	3·79	6·23
Silica	10·12	11·80	17·80	10·44	14·60	6·80	11·20
Bituminous matter	2·32	1·55	4·17	1·75	2·84	0·73	2·03
Water	0·56	0·75	0·66	0·97	1·19	0·52	1·10
	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	36·80	30·87	27·30	29·21	25·49	19·63	29·44
Specific gravity	3·529	3·395	2·912	3·261	3·126	2·884	3·093
Yield of Calcined Ore, per cent	72·16	70·39	72·28	67·80	68·53	64·77	70·94
Iron in Calcined Ore	51·00	43·84	37·77	43·08	37·19	30·38	41·50
Silica in Calcined Ore	14·03	16·77	24·62	15·40	21·30	10·50	15·77

(To be continued.)

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 4.)

The Sulphur Industry of Sicily.
By Dr. Angelo Barbaglia.

The duration of the process, from the commencement of charging till the last roll of sulphur has been cast, varies with the capacity of the furnace, the nature of the ore, and the condition of the atmosphere. In furnaces of equal size the operation is the more prolonged the denser the ore and the colder the weather. Wind promotes whilst rain retards the combustion. On an average we may assume that the melting requires, for furnaces containing:—

50 to 60 cassas	30 to 35 days
200 „ 250 „	50 „ 60 „
400 „ 500 „	80 „ 90 „

Both in the calcarone and in the calcarella a part of the sulphur is burnt in order to furnish the heat required for the fusion of the rest. The consumption of sulphur for this purpose fluctuates greatly and depends on very various conditions. It is particularly large if the ore is very gypsiferous and contains consequently much water, or if it has been placed in the furnace when moist, or if violent rains have fallen during the burning. In long-continued rains an operation sometimes miscarries entirely. In a successful operation with an ore containing 25 per cent of sulphur, 70 per cent of marly limestone, and 5 of water, theoretically, the combustion of 1-5th of the sulphur should be sufficient, but in practice 1-3rd and even 2-5ths are consumed.

It need scarcely be mentioned that methods have been proposed to obviate this loss, and especially to protect the neighbouring population against the pernicious influence of an atmosphere polluted with sulphurous acid.

At Lercara, where, for a length of time, very rich ores (*talamone*) were exclusively obtained very friable, and, therefore, unsuitable for burning in calcaroni, the fusion has long been conducted in open cast-iron pans, of semi-circular section, heated by means of vegetable fuel. The expense of melting amounted to 2·50 lire per 100 kilos. In each operation 8 to 9 quintals of sulphur were obtained, and 2 to 3 quintals of fuel consumed. The pans served from four to five years. At the sulphur mines of Madora (Province Lecara), where very poor ores have to be worked, this method is not applicable. Durand introduced there the furnace bearing his name. It consists of a quadrangular chamber of masonry, each side measuring 2 metres, with a sloping bottom and a vaulted roof, in the midst of which is an opening for charging and emptying the furnace. In the lower part of the front wall is the tap hole, and on each side is an aperture, the one to kindle the furnace and the other to remove the products of combustion. In such a furnace containing 1½ cassas a fusion (including the time for charging and emptying) lasts twenty-four hours. The process is otherwise conducted as in the calcarone.

Another furnace was built in 1861 by Conrad Hirzel, at the Solfara Col di Serio, in the province of Lercara. By means of this apparatus, which was patented by the inventor, the fusion is effected more rapidly, and every loss, whether by sublimation or by combustion of the mineral, is said to be avoided. But this arrangement, though ingenious, is complicated, and the result has generally not come up to expectation, so that after two years the furnace has been abandoned. An apparatus introduced almost simultaneously by Joseph Gill, at the Solfara della Croce (Lercara), which was to effect the fusion of the sulphur by means of hot air deprived of oxygen, as also the system devised by Heinrich Keyser for extracting the sulphur by sublimation in cast-iron or earthen retorts, have met with no better fate. The latter process seems at the best merely serviceable for the treatment of very rich powdered ore (*sterri*) and only for the manufacture of flowers of sulphur.

The proposal of H. Condy Bell (1867) to extract the ores in the moist way with the bisulphide of carbon has not been successful. According to experiments made in 1868 at Bagnoli, near Naples, insurmountable difficulties were met with in the attempt to carry out the process on the large scale.

We must also mention the attempts at extracting the sulphur by means of high-pressure steam. The suggestion was made many years ago by Joseph Gill, but experiments on the large scale were first undertaken by Thomas at Palermo, in 1868. The process has been patented by a company, the *Societa privelegiata per la fusione dello solfo, in Italia.*† The process requires the use of ordinary fuel. Steam is used at a tension corresponding to the melting-point of sulphur. Theoretically a pressure of 2 atmospheres should suffice; practically from 3 to 3½ atmospheres are required. A higher pressure would impair the quality of the sulphur.

Not more then 6 or 7 fusions daily can be effected by means of this system, 2 tons being treated each time. In a successful operation not more than 5 per cent of the sulphur originally present remains in the residue, so that an ore of 22 per cent on fusion in steam yields 21 per cent, whilst the process in the calcarone yields merely 15 per cent. This increased production approximately covers the working expenses. Still it must be remembered that Sicily possesses no fuel, and that 60 *lire* is no unusual price for a ton of imported coal. The metal apparatus required is also expensive, not to mention the outlay for the importation of machinery. For the present it must remain undecided whether the steam-fusion process is calculated to supersede the old method. For the treatment of very poor ores the former seems already more advantageous. The company above mentioned have undertaken the fusion of the ores on their own account, taking as payment a percentage of the yield, whilst the rest remains the property of the mine-owner. This percentage varies according to the nature of the ore; at della Croce it is 32 per cent, but in Madore, Montedoro, and Sommatino only 29.

It must not be forgotten that on account of the different nature of the material operated on, the results in different mines vary greatly. Hence in some places where the new process had been introduced it has been again abandoned, whilst in others its retention is still doubtful.

The purification of sulphur is still principally carried on in France, especially in the neighbourhood of Marseilles. In Sicily there are only two or three refineries (at Catania and Porto Empedocle), which only work at intervals and on a small scale.

(To be continued).

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Compare also the essay on the utilisation of alkali waste (regeneration of the sulphur) in a subsequent portion of this report.

PROCEEDINGS OF SOCIETIES.

RUSSIAN CHEMICAL SOCIETY.

Julie Lermontoff, *Preparation of Normal Propylyen Bromide (Trimethylen Bromide).* Allyl mono-bromide, if saturated at $-10°$ with HBr, and heated in a sealed tube for a day at 170°, yields almost pure trimethylen bromide. The method is therefore much preferable to that of Reboul and Köser, hitherto used.

O. Miller, *On Iso-dibrom-anthracen.* This compound, $C_6H_4.C_2H_2.C_6H_2.Br_2$, was obtained by the reduction of

dibrom-anthraquinon. It melts at 120°, and is easily oxidised back to the original body.

W. MARKOWNIKOFF, *On the Presence of Aceton in Diabetic Urine.* The author's investigations have led to the detection of large quantities of aceton as well as alcohol in diabetic urine, the origin of which he attributes to the action of a special ferment.

A. SABANEJEFF, *Preparation and Properties of Dibrom-acetylen.* This compound, $C_2H_2Br_2$, was obtained pure by the action of zinc upon an alcoholic solution of tetra-brom-acetylen. It is a mobile liquid, possessing an odour similar to that of chloroform, and boiling at 106°.

A. SABANEJEFF, *Action of Hydrobromic Acid upon Aconitic Acid.* The reaction yields $C_6H_6O_6HBr$, from which an acid, apparently isomeric with citric acid, is obtained by treatment with oxide of silver.

D. PAULOFF, *Action of Monochlorinated Acids upon Zinc Hydrocarbons.* See abstract of papers read before the St. Petersburg Academy (CHEMICAL NEWS, vol. xxxv., page 8).

M. SCHALFEEF, *On Cerotic Acid.* An examination of the supposed cerotic acid, $C_{27}H_{54}O_2$, obtained by Brodie's treatment from bees'-wax, produced in various regions, shows that it is a mixture of several acids. By partial precipitation of the lead salts the author was able to obtain but one pure. This melts at 91°, and corresponds to the formula $C_{34}H_{68}O_2$.

ACADEMIE DE ST. PETERSBURG.

November, 1876.

A. BUTLEROFF, *On Di-iso-butylen.* The author combats vigorously the theory of Schneider that the condensation-products of the olefines are entirely different from the hydrocarbons of the ethylen series, basing his opinions on the following researches:—Trimethyl-carbinol treated with sulphuric acid at 100° yields di-iso-butylen, C_8H_{16}, a colourless mobile liquid boiling at 102·5°. It easily takes up halogens and the hydrogen acids of the halogens. The compound with HI, upon treatment with oxide of silver, gives an acetyl alcohol, solidifying at −20° to a white crystalline mass. The hydrocarbon and its alcohol yield upon oxidation with chromic acid and meta-phosphoric acid identical products—carbonic acid, aceton, acetic acid, trimethyl-acetic acid, a new octyl acid, $C_8H_{16}O_2$, and a keton, $C_7H_{14}O$. From these properties the formula—

$$(CH_3)_2.C.CH.C.(CH_3)_2$$

is assigned to di-isobutylen.

NOTICES OF BOOKS.

The Textile Colourist: a Monthly Journal of Bleaching, Printing, and Dyeing. Edited by C. O'NEILL, F.C.S. (Vol. II.) Manchester: Palmer and Howe. London: Simpkin and Marshall.

THE contents of this volume are correctly indicated by the title. We find papers on the formation of aniline-black, on its analysis, constitution, and tendency to turn green on exposure to reducing agents; on the colours of Croissant and Bretonnière, and on the kindred article known as "Laval catechu;" on the naphthylamin colours; on the new indigo-vat of MM. Schützenberger and Lalande; on the colouring matters from resorcin, &c. These memoirs are chiefly translations or abstracts taken from Continental journals or serials, such as the *Bulletins* of the Industrial Societies of Rouen and Mulhouse, the *Moniteur Scientifique*, &c. There is also a collection of dyeing and printing receipts from a French work by M. de Vinant, and a collection of miscellaneous receipts, concerning which we are told that the editor does not hold himself answerable either for their accuracy or their goodness—a very judicious reservation, since, as we learn, a large part of the public are under the impression that the editor of a scientific or technological journal verifies every process described in his columns.

On the question of the physiological action of the aniline colours, certain experiments are given which would cause them—magenta at least—to be regarded as innocent, if pure, a conclusion which we should be slow to adopt.

In Mr. Jarmain's lectures on wool-dyeing, as delivered before the Society of Arts, the method there described of testing waters for tinctorial purposes by means of a decoction of logwood, whatever its practical value, is not original, having been in print now for several years. The same remark applies to the treatment of the purification of the refuse from woollen mills by running all into a common reservoir. Mr. Jarmain's words, as quoted by Mr. O'Neill, would lead the reader to believe that this was an original observation.

An appendix to the volume contains a systematic treatise on dyeing and printing. The portion of this memoir relating to thickenings must be pronounced able and judicious. That on mordants is much less satisfactory.

Some typographical errors of a puzzling nature occur in the volume. Thus a "dichröic" substance is spoken of as "dichloric," and the locality of the new dye-ware "Lucee" is given as "Guyan,"—probably Cayenne.

A Systematic Handbook of Volumetric Analysis, or the Quantitative Estimation of Chemical Substances by Measure, applied to Liquids, Solids, and Gases. By FRANCIS SUTTON, F.C.S. (Third Edition.) London: J. and A. Churchill.

THOSE who are familiar only with Mr. Sutton's "Handbook" as it first appeared will scarcely be able to recognise it in its present form. In bulk it has been at least doubled, a considerable part of the increase being due to certain sections on the analysis of potable water and sewage, contributed by Mr. W. Thorp. This "monograph on the analysis of waters" Mr. Sutton pronounces a "special feature," and expresses the belief that it "will be found well worthy the attention of all chemists." On this question we offer no remarks, being well aware, as we have declared elsewhere, that nothing finds its true level more certainly than an analytical process. There is also a section on the volumetric estimation of gases.

The main part of the work is enriched with methods for the determination of tannin, which the author admits are not of the most satisfactory character. For the valuation of indigo the methods of McKinlay (bichromate of potash with oxalic acid) and of Ullgren (red prussiate) are given. Cochineal and lac-dye are not mentioned. Volumetric methods are given for the determination of cobalt and nickel, as proposed by Künzel and Winckler. The application of these processes, however, is somewhat limited. A method for bismuth is given. For the analysis of chrome-iron we find, in addition to the method given in the first edition, one by Britton. The section on copper has been considerably enlarged, the process of Steinbeck having been given, but not that of Luckow.

Upon the whole it can scarcely be said that volumetric analysis has made latterly such progress as might have been anticipated.

*Hofmann's Polarimeter, and its Use as a Saccharimeter and Diabetometer.** By H. SOUCLIER. Paris: A l'Institut d'Optique du Docteur J. G. Hofmann.

THIS pamphlet consists of a description of Hofmann's polarimeter and its use in saccharimetry. It would be impossible for us to describe the construction of the instrument in an intelligible manner without the aid of the accompanying illustrations.

* Le Polarimetre Hofmann a franges son emploi comme Saccharimétre et Diabétométre.

*Brief General Introduction to the Aromatic Nitro Compounds.** By P. Townsend Austen. Leipzig and Heidelberg: Winter.

The author of this pamphlet has undertaken to give a view of the most important facts relating to the nitro-compounds. Want of space has compelled him to omit certain points, such as the physiological action and the practical applications of the nitro-compounds, the relative position of the nitro-group in the molecule, &c. He discusses in succession the constitution and influence of the nitro-group; the preparation of the nitro-compounds; their reduction to azoxy-, azo-, and amido-compounds; the use of different reducing agents, such as ammonium sulphide, zinc, iron, and tin along with an acid, hydriodic acid, &c.; the general reactions of the nitro-compounds, their decomposition by reduction, the direct substitution of the nitro-group by chlorine, &c.; the replacement of the nitro-group by the carboxyl-group, the transformation of the amido-group into the hydroxyl-group; the action of potassium cyanide upon the nitro-phenols; the compounds of the hydrocarbons with picric acid; the abscission of water on the reduction of certain nitro-acetamides; the oxidation of the nitro-compounds, and their behaviour with alkalies, ammonium sulphite, and sulphuric acid. The literature of the subject has been very carefully digested, and the reader finds continual references to the original memoirs.

The History of Copper Extraction by the Wet Way. By William Henderson. Glasgow: W. Macrone.

This essay, "taken as read" before the British Association at its last meeting, consists merely of a discussion of the claims of various persons to the invention of the process in question. We merely note the interesting fact that the Alderley Edge copper mines, though producing an ore which by the Cornish assay yield nothing at all, have paid dividends to the extent of nearly £40,000.

CORRESPONDENCE.

PLASTER HARDENING AND THE GERMAN GOVERNMENT.

To the Editor of the Chemical News.

Sir,—More than twelve months ago a reward was offered for the best means of hardening plaster-of-Paris so as to enable objects cast from it to stand weathering, and allow of their being washed, &c., without injury to fine lines of projection. The advertisement seemed to bear the stamp of official authority, and doubtless many, like myself, were induced to make experiments and to send specimens to the address given. Has anyone who did this heard, or does anybody also know, anything further of the matter, or was the whole affair a hoax, or an attempt to get what was required for nothing? I shall feel grateful for information on the subject.—I am, &c.,

J. L. D.

January 9, 1877.

MILK ANALYSIS.

To the Editor of the Chemical News.

Sir,—I send herewith the results obtained on analysing samples of milk given by ordinary Jamaica cows and goats, as possibly they may be of interest to chemists interested in the milk question. Each sample was supplied by a friend to whom I had given directions respecting the manner of taking it, which I have every reason to believe were carefully followed, and that, therefore, the results given below may be relied on as truly representing the average composition of the milk yielded by the various animals at one milking.

The total solids were determined by drying 5 c.c. on the steam bath for three hours in a platinum dish, and the ash by igniting the dry residue.

The fat was determined by evaporating 10 c.c. in a porcelain basin on the steam bath for about an hour, by which time, if the milk has been frequently stirred so as to break the films which form, no visible moisture will remain, but the residue will not be hard and brittle; it is now detached from the basin by means of a small steel spatula cut down to a blade of about two inches long and properly rounded and sharpened. With this instrument the milk residue is readily removed, and cut up sufficiently small to be easily transferred to a glass bulb of the form of the annexed figure, and of a capacity of from 20 to 30 c.c., the capillary end of which has been first fused, and the expanded portion immediately below the bulb packed with fine cotton-wool. The spatula, stirring-rod,

Bulb for extracting fat from evaporated milk residue.

Cotton-Wool.

Capillary point which can be renewed by drawing out the larger portion immediately above it.

and basin are now well washed with dry ether, which, if poured into the bulb, its mouth closed with a cork and allowed to stand till next morning, when the capillary point is broken off and the ether solution of butter allowed to run into a tared basin standing over warm water, grasping the bulb in the hand will cause the last drop of the solution to be discharged. Fresh ether is now poured into the bulb and allowed to run through; this is repeated three times, when all the butter will be extracted; the residue is turned out of the bulb, the cork replaced, and the capillary end fused, and the bulb put by ready for the next determination. The basin containing the butter is heated for a short time on the steam bath, cooled, and weighed.

I find this a very convenient and accurate method of finding the quantity of fat; the results rarely disagree more than a few hundredths of a per cent. In colder climates it may be practicable to apply the ether to the residue in the porcelain dish, but here I find I cannot work with ether in open vessels. The cotton-wool entirely prevents any solid particles from falling into the tared basin, and by the repeated washings is left free from fat and ready for another analysis.

The tube at *a* is about 1·5 centimetres in diameter and that at *b* about 2 millimetres.

* Kurtze Allgemeine Einleitung zu den Aromatischen Nitro Compounds.

	Parts by weight in 100 c c.			
	Total Solids.	Fat.	Ash.	Solids not Fat.
At one milking—				
Milk given by 5 cows ..	13·60	3·34	0·72	10·26
" " 4 " ..	13·85	3·97	0·73	9·88
5 quarts from 1 cow ..	12·97	2·26	0·84	10·71
5 " " ..	12·68	2·73	0·71	9·95
5 " " ..	14·83	4·97	0·76	9·86
5 " " ..	14·68	4·55	0·73	10·13
4 " " ..	11·77	1·52	0·74	10·25
4 " " ..	13·12	3·20	0·73	9·92
Goats' milk	18·39	7·68	0·89	10·71
Do.	17·44	7·12	0·68	10·32
Do.	18·33	8·24	0·74	10·09
Do.	18·51	7·89	0·80	10·62

(Each sample was from different animals.)

—I am, &c.,

JAMES JOHN BOWREY.

Kingston, Jamaica, November 9, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 26, December 27, 1876.

Analysis of Pyrogenous Gases.—M. Berthelot.—Reserved for insertion in full.

Certain Derivatives of Dialdol.—M. A. Wurtz.—These are dialdane, $C_8H_{14}O_3$, and dialdanic acid, $C_8H_{14}O_4$. The author has described several of the salts of the latter.

Researches on the Coefficient of Capillary Efflux.—M. A. Guerout.—In the ethers the decrease of the coefficients in proportion as the carbon increases is maintained in a perfect manner. The coefficient of the capillary efflux of the ethers is much higher than that of the alcohols or the acids from which they take their rise; that is to say, the introduction of an organic radical into the molecule of an alcohol strikingly increases the fluidity of the compound.

Practical Study on Gluten, and on its Determination in the Dry State.—A. Lailler.—The author insists that the determination of gluten in the dry state is the only practimeans of arriving at an exact valuation of grain, flour, &c.

New Globular Condition of Quartz Entirely Crystallised.—M. A. Michel Levy.—The author has found in a specimen of porphyry from Morvan a new globular condition of quartz, which seems to him to fill up the interval between crystalline quartz with exterior polyhedric surfaces and chalcedony, which Des Cloiseaux defines as an intimate mechanical mixture of amorphous and crystalline quartz.

Moniteur Scientifique, du Dr. Quesneville, December, 1876.

Memoir on the Preparation of Dextrin-Maltose.—W. G. Valentin.

Action of the Extract of Malt upon Starch.—C. O'Sullivan.—These two papers are derived from English sources.

Analytical Function of the Liver.—Dr. Quinquand.—The liver, if left to itself, gives rise to the same products which exist when it is destroyed in acute yellow atrophy. The chemical process is a splitting up of the albuminoid and collagenous bodies.

Compass with Circular Magnets of M. Emile Duchemin.—This paper consists chiefly of testimonials sent by captains of vessels as to the practical value of the new compass.

Determination of Nitric Acid in Organic Substances, and Chemical Composition of Various Gun-Cottons.—MM. P. Champion and Pellet.—Already noticed.

Colouration of Wines with Artificial Dyes derived from Coal.—M. C. Girard.—For the detection of magenta in red wines preference is given to the method with baryta and amylic alcohol. It is considered that the use of wines so sophisticated may injure health.

Glycero-phosphoric Acid and its Salts.—J. L. Thudichum and C. T. Kingzett.

Certain Reactions of Biliverdin.—J. L. Thudichum.

Action of Alcohol on the Brain.—C. T. Kingzett.

Alkaloid Extracted from Jaborandi.—C. T. Kingzett.—These four papers are from English sources.

January, 1877.

Detection of Rosolic Acid in Presence of Magenta.—MM. Guyot and Bidaux.—Already noticed.

New Researches on the Action of Non-arsenical Magenta introduced into the Stomach and the Blood.—MM. Feltz and Ritter.—Magenta introduced into the stomach invariably produced albuminuria, and when injected into the blood lesions of the cortical substance of the kidneys, and in one case well marked symptoms of dropsy, were observed.

Processes for the Detection of Magenta in Wines.—M. Fordos.—Already noticed.

Determination of Saccharine Matters by means of Standard Solutions.—M. E. Perrot.—Already noticed.

Procedure of MM. Kœchlin Frères to avoid the Greening of Aniline-Blacks.—Aniline-blacks, if submitted to acid reducing agents—such as sulphurous acid and sulphuretted hydrogen—take a greenish colour, due to their more or less complete conversion into emeraldin, which is deep blue in an alkaline state, but is rendered green by the slightest traces of acid. There is a product more highly oxidised than aniline-black, which is no longer transformed into emeraldin by reducing agents, whether acid or alkaline, and which is obtained as follows:—Aniline-black, printed and fixed, is finished as usual, and then submitted in a beck to an acid oxidation at a temperature above 75°. It is then merely required to soap, or simply to wash the pieces. Among the oxidisers which give the best results are the salts of ferric oxide, chromic acid, certain chlorates easily decomposed, such as the chlorate of alumina. The ferric solution is prepared from a per-salt of iron, mixed with 1 to 1½ times its weight of sulphuric acid at 66° B., to prevent the iron from being fixed upon the fibre. This solution is employed in the proportion of 1 to 2 grms. per litre, say 1 to 2 litres to a dye-beck for six to eight pieces, which are passed through it from half an hour to an hour at 80°. As the ferric salts are less generally met with in trade than the ferrous salts, a solution may be prepared as follows:—Ferrous sulphate, 20 kilos., dissolved in 60 to 70 litres of water. To this are added 5 kilos. bichromate of potash, dissolved in 15 to 18 litres sulphuric acid at 66° B. From 4 to 8 litres of this liquor are taken and applied as above. For black and orange styles chromic acid is employed in the proportion of 300 to 400 grms. to a beck for six to eight pieces, or 300 to 400 grms. bichromate and ½ litre sulphuric acid, proceeding as with the iron. The orange is then raised with an alkaline chromate. For black and fast blue styles a slight excess of ferrous salt must be left in the liquor, as chromic acid would destroy the blue. the formula given above 4 kilos. of bichromate are used n place of 5.

Greening of Aniline-Blacks.—M. Camille Kœchli

—To avoid the "greening" of aniline-blacks was a problem laid before chemists. They were not ignorant of a process which gives a black incapable of turning green. In it the metallic salt of Lightfoot—copper or vanadium—is replaced by a ferricyanide. This substitution, brought into practice by M. H. Cordillot, in the firm of Schwartz-Huguenin, a short time after the discovery of the black, merely requires, in order to attain the required solidity, and not to turn green, merely to be sufficiently steamed after ageing. This aniline-black does not attack the doctors, it weakens the fibre less than any other, and it bears steaming; but being dearer, and not keeping so well when mixed, it was unfortunately neglected at a time when the question of "greening" had not been raised. We have, as a further instance, the black iron-lakes of aniline; the aniline-greys obtained by direct fixation with a concentrated and boiling solution of chromate of potash, as well as the naphthylamin-garnets obtained by the same process, colours which remain unaffected by atmospheric reducers. Lastly, we must bear in mind the practice of certain English printers, who steep in chloride of lime between aëration and washing. The exceptional property of the ferricyanide-black suggested the idea of trying the action of ferricyanides upon ordinary blacks already fixed upon cloth. Under the action of alkalies, which have so powerful an influence upon organic substances, the ferricyanides merely behave like the hypochlorites; the black is reddened without being rendered incapable of turning green. It is not the same with hydro-ferricyanic acid. The reaction becomes identical with that of the steamed ferricyanide colour, and the blacks resulting have lost all sensibility to sulphurous acid. M. Jeannaire, who invented this process, did not succeed in utilising it on account of the blue colour which it deposits upon the cloth. He had recourse to another ferric compound, the acid nitrate. In it the blacks acquire the wished-for solidity, and those even which had turned green are rendered incapable of "greening." Aniline-black as developed by mere ageing is therefore a black of incomplete composition. This fact being established, the methods were no longer restricted to ferric nitrate. Other chemists added chromic acid, concentrated chromates (before washing), chloro-chlorate of alumina; procedures which find an application according as the black is accompanied by catechu, or by chrome-yellow, or by madder-red, &c. When the process of Kœchlin Brothers began to be talked of, MM. Depuis and Durand simultaneously added to it nitrites. These compounds required a lower temperature, and were without effect on the colours. These advantages induced MM. Durand and Huguenin, of Bâle, to offer a product of their manufacture, sulpho-azotic acid, a compound which M. Guinon, of Lyons, has employed for forty years in the fixation of catechus. On becoming incapable of turning green the black attains its greatest beauty, the maximum of oxidation coinciding with the maximum of colouration. It loses its violet tone, a loss which might degenerate into impoverishment if the black is not sufficiently intense, or if the fixing liquor is too strong. It should always be added by small quantities, especially in presence of indigo.

The Conception and Mode of Representation of Benzolic Nuclei in Rational Formulæ.—M. Méhay.—Not adapted for abstraction.

Certain New Salts of Bismuth, and their Use in the Detection of Potassa.—M. A. Carnot.—Already noticed.

New Process for the Detection and Determination of Potassa.—M. A. Carnot.—Already noticed.

Determination of the Alkaloids in the Cinchona Barks.—M. J. C. Bernelot Moens.—Not capable of abstraction.

The remaining papers, viz.—"Monobromated and Dibromated Camphor," by J. Montgolfier; "Colouring Matter of Blood," by A. Béchamp; "Certain Purple Colours derived from Cyanogen," by Gaston Bong; and "Researches on the Carbon of White Iron," by MM. Schützenberger and A. Bourgeois, have been already noticed.

Justus Liebig's Annalen der Chemie,
Band 183, Heft 2 and 3.

Studies on the Anthraquinon Group.—Carl Liebermann.

Studies on the Naphthalin Group.—Carl Liebermann.—Two very valuable papers, but quite incapable of useful abridgment.

Communications from the Laboratory of the University of Halle.—These communications consist of a paper on dehydro-triacetonamin: on the sixth aceton base; on the alcoholic bases arising by hydrogenisation of di- and triacetonamin; and on a new platinum salt containing two distinct ammonia bases, all by W. Heintz.

Communications from the University of Erlangen.—These include a paper on ostruthin, by E. von Gorup-Besanez; and one on melyssic alcohol and certain of its transformation products, by L. von Pieverling.

On Pyrosmalith.—E. Ludwig.—The author gives the composition of this mineral as—

Silicic acid	34·66
Ferrous oxide	27·05
Manganous oxide	25·60
Lime	0·52
Magnesia	0·93
Water	8·31
Chlorine	4·88
	101·95

Or, deducting the amount of oxygen equivalent to the chlorine, 1·10, making a total of 100·85.

Preparation of the Earthy Metals in the Chemical Works of Dr. Schuchardt, at Görlitz.—E. Frey.—Calcium, strontium, lithium, and cerium are prepared in quantity in this establishment by Bunsen's electrolytic process. A current of 60° is found more serviceable than one of 90°, as originally recommended by Bunsen. Calcium is not of a brassy yellow, but exactly resembles aluminium in appearance. It is brittle, and cannot be laminated or drawn out to wire. Strontium is a pale brassy-yellow metal, very pliable, and capable of being rolled and drawn, but it oxidises more readily than calcium. Barium has not yet been obtained by this process in a compact state, owing to its elevated melting-point, which appears to be higher than that of cast-iron. From the amalgam the metal was obtained not in a fused, but in a fritted state, in masses exceeding 100 grms. in weight. This was effected by distilling off the mercury in a wrought-iron retort, fitted with a ground lid, into which two iron tubes were screwed. The retort, coated with clay, was exposed to the most intense heat, whilst a continuous current of dry hydrogen was passed through it. Small globules of lithium were fused in an iron capsule to masses of nearly 2 grms. in weight. Cerium prepared by the electrolytic process has all the properties described by Wœhler in 1867. It is particularly distinguished by its brilliant and explosive combustion.

Band 184, Heft 1 and 2.

Action of Phosphorus Pentachloride upon the Amides of Acids.—O. Wallach.—In this paper is examined, first, the action of the pentachloride upon ordinary amides of acids; secondly, upon the substituted amides of the oxalic acid series, diethyloxamid, dimethyloxamid, ethyl- and methyl-oxamethan, and the behaviour of methyl-ethyl-oxamid; and, lastly, the action of the pentachloride upon the substituted amides of monobasic acids.

Constituents of the Cumol of Coal-Tar, and on their Separation.—Oscar Jacobsen.—A lengthy paper, not capable of useful abstraction.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

History of Chemistry.—I would feel very much obliged if any of your numerous subscribers would kindly inform me as to where I could read a good account of the early history of chemistry, such as the science was about 80 years ago.—ENQUIRER.

MEETINGS FOR THE WEEK.

MONDAY, Jan 22nd.—London Institution, 5.
—— Medical, 8.
—— Royal Geographical, 8.30.
TUESDAY, 23rd.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Anthropological Institute, 8
—— Society of Arts, 8. (African Section). "The Trade of Central Africa, Present and Future," by Commander Cameron, R.N., C.B.
WEDNESDAY, 24th.—Society of Arts, 8. "Silkworm Grain," by B. Francis Cobb.
—— Geological, 8.
THURSDAY, 25th.—Royal, 8.30.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Philosophical Club, 6.30.
FRIDAY, 26th.—Royal Institution. Weekly Meeting, 8. Sir John Lubbock, Bart., "On Ants," 9.
—— Quekett Club, 8.
SATURDAY, 20th.—Royal Institution, 3. Mr. Ernst. Pauer, "On the Nature of Music: the Italian, French, and German Schools (with Pianoforte Illustrations).

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THE CHEMICAL NEWS

VOL. XXXV. No. 896.

DINITROSO-ORCIN AND DINITRO-ORCIN.*

By J. STENHOUSE and C. E. GROVES.

ALTHOUGH numerous nitro-derivatives, both of hydrocarbons and of alcohols, have been prepared and examined, the nitroso-derivatives, or those which contain the NO group in place of hydrogen, were almost unknown until within a recent period, and even now the number of those which have been investigated is very small.

Dinitroso-Orcin.—It seemed probable that as Fitz had succeeded in preparing dinitroso-resorcin by the action of potassic nitrite and acetic acid on resorcin in aqueous solution, a corresponding derivative of orcin might be obtained by a similar method; and, in fact, it was found that under these circumstances a substance was formed having properties closely resembling those of dinitroso-resorcin, leaving no doubt as to the nature of the new compound. The quantity obtained in this way, however, being but small, and the product far from pure, an attempt was made to prepare it by passing nitrous anhydride into a solution of orcin: the liquid became deep yellow, and on standing some time deposited nitroso-orcin as a brown powder. It was found, however, that it could be far more conveniently prepared by adding the requisite quantity of lead-chamber crystals or nitrosyl sulphate,—

$$\left.\begin{matrix}NO\\H\end{matrix}\right\}SO_4,$$

dissolved in concentrated sulphuric acid, to a dilute aqueous solution of orcin, the amount of nitrosyl sulphate employed being slightly in excess of that represented by the equation—

$$C_7H_6(OH)_2+2\left.\begin{matrix}NO\\H\end{matrix}\right\}SO_4=C_7H_4(NO)_2(OH)_2+2H_2SO_4.$$

As it is necessary to avoid as far as possible any admixture of nitric acid, care must be taken in the preparation of the nitrosyl sulphate. The method found to answer best consisted in passing the product of the action of nitric acid of specific gravity of 1·3 on arsenious anhydride at 70° C. into concentrated sulphuric acid.

Very shortly after adding the nitrosyl sulphate the dinitroso-orcin begins to make its appearance as a pale yellowish brown powder, which, after the mixture has been allowed to stand for eighteen to twenty-four hours, may be collected, washed thoroughly, and dried at a gentle heat. As this compound is comparatively insoluble in most solvents it is necessary to convert it into the ammonium compound in order to purify it. This is done by suspending it in about ten times its weight of alcohol, and carefully adding alcoholic ammonia in small quantities at a time until the brown powder is entirely converted into the green crystalline ammonium salt, finally adding a slight excess of the ammonia. After ten or fifteen minutes the green salt is collected, pressed, suspended in water, and decomposed by dilute sulphuric acid. A second treatment of the product with alcoholic ammonia suffices to render it pure.

Pure dinitroso-orcin, $C_7H_4(NO)_2(OH)_2+2OH_2$, is a pale coloured crystalline powder, which is almost insoluble in water, alcohol, ether, benzene, &c. It dissolves on being boiled with alcohol for some time, but is decomposed. Heated in a narrow tube it begins to become dark rapidly at 110°, but without fusion, and at 140° C. is almost black. Heated rapidly on platinum foil it fuses and decomposes, but without decomposition. The potassium, sodium, and ammonium derivatives of dinitroso-orcin are green crystalline compounds, but the salts of the alkaline earths and heavy metals are brown amorphous precipitates.

Dinitro-Orcin, $C_7H_4(NO_2)_2(OH)_2$.—Strong nitric acid acts readily on nitroso-orcin, especially when heated, forming trinitro-orcin, together with some oxalic acid. With dilute nitric acid in the cold, however, the action is different; the nitroso-orcin becomes red, and after standing twenty-four hours is converted into an orange-coloured crystalline powder, consisting chiefly of dinitro-orcin. This is purified by crystallisation from ether and from alcohol. Dinitro-orcin crystallises in deep yellow rhomboidal plates, which melt at 164·5°, and with care may be sublimed at a higher temperature. Heated rapidly on platinum foil it deflagrates. Dinitro-orcin is very soluble in ether, and moderately soluble in cold alcohol, but almost insoluble in cold water, carbon bisulphide, and petroleum. Heated with concentrated nitric acid it is converted into trinitro-orcin, $C_7H_3(NO_2)_3(OH)_2$.

The derivatives of dinitro-orcin containing the alkali metals or ammonium are very soluble in water, and difficult to obtain in the crystalline state. With barium it forms two compounds, one of which, obtained when excess of baryta is employed, is almost insoluble in water, and of a deep crimson colour; the other, which has the composition $[C_7H_4(NO_2)_2OH]_2BaO_2+OH_2$, is slightly soluble in boiling water, but crystallises out almost completely on cooling in long silky needles of a brilliant orange colour.

The authors find that nitrosyl sulphate may be employed advantageously in the preparation of nitroso-phenol, nitroso-thymol, nitroso-naphthol, and dinitro-resorcin, the yield in the case of the last-mentioned substance exceeding 96 per cent of the theoretical amount, whilst Fitz, by the employment of potassic nitrite and acetic acid obtained only 80 per cent.

Abstract of Paper read before the Chemical Society, Jan. 18.

ON THE GROWTH OF THE ALKALI AND BLEACHING-POWDER MANUFACTURE OF THE GLASGOW DISTRICT.*

By JAMES MACTEAR.

(Concluded from p. 25.)

Part V.—CAUSTIC SODA.

THE production of caustic soda was begun at the St. Rollox Works as far back as 1844, by means of a process introduced by a Mr. Weisenfeldt. It was made from the red liquors fused with nitre, and was perfectly white; but there being little or no demand for the article, the manufacture was for the time given up.

The manufacture was again resumed about fifteen months ago, and the various qualities and strengths of—

Cream or unfused	.. ..	60 per cent
White or fused	.. ..	60 ,,
Do.	.. ..	70 to 72 ,,
White, double refined	..	74 to 76 ,,

are now manufactured.

Part VI.—MANGANESE RECOVERY.

The recovery or regeneration of the manganese contained in the residuum from the bleaching-powder manufacture was the object of constant investigation. Various methods were tried with but little success; amongst others, those of Binks and of Gossage.

The process still worked at St. Rollox is one invented by Mr. C. T. Dunlop, in 1855, in which the acid still liquors are first neutralised with chalk, and the settled liquor is decomposed under pressure by milk of chalk; the carbonate of manganese thus obtained is washed, dried, and submitted to a heat of about 600° F. for 48 hours, when it gives a black oxide of manganese of high strength.

A description of the process is given in most modern works on technical chemistry.

* Read before the Chemical Section of the British Association Glasgow Meeting, 1876.

This method of recovering manganese is not in use at any other chemical works, the method now universally adopted being that invented by Mr. W. Weldon, which has been adopted by Messrs. C. Tennant and Co., at their works at Hebburn, near Newcastle-on-Tyne, in preference to extending the Dunlop process to that establishment.

Mr. Weldon's process is used, I understand, by all the other makers of bleaching-powder in Scotland.

Part VII.—Sulphur Recovery.

The position of the St. Rollox Works, and the enormous deposits of alkali waste which have accumulated during the long period of their existence as alkali works, caused the question of the recovery of the sulphur from the waste, or from the drainage liquor from the heaps, to become a very serious one. These drainage liquors at one time flowed into a stream called the Pinkston Burn, and from thence found their way into the Kelvin, and ultimately into the Clyde.

Many processes were devised and tried to keep down this flow of drainage, and a very large sum was spent in driving a series of galleries deep down in the rock under the waste heaps, to try, if possible, and intercept a number of springs of water, which, rising under the heaps, dissolved and carried away the soluble sulphur compounds of the waste.

It was not till the beginning of 1868 that a process was at work in a way that might be called successful. It was one adapted by Mr. Ludwig Mond, and consisted in oxidising the fresh exhausted waste while still in the vats by blowing air through, and then using the liquor draining from the heaps instead of water to dissolve out the sulphur compounds.

This process was worked for some years, but had two defects. There was a considerable amount of sulphuretted hydrogen given off in the process of oxidising, and it was not found possible to utilise by this process all the drainage, which was produced in large quantity.

It was superseded in 1871 by a process invented by the writer, which has been very successful, reducing the nuisance arising from these liquors to a very small amount. There is now absolutely no drainage flowing into the Kelvin; and only in such exceptional cases as that of excessive rainfall, diluting the liquor in the natural reservoir in which it is collected to a point at which it could not be worked to advantage, is any run into the Clyde.

The process is being gradually improved; and it is hoped that before long absolutely no drainage of this liquor shall find its way into the river.

I am happy to say that the recovery of sulphur from these liquors, at first undertaken in order to abate a nuisance at no matter what cost, and which was not expected to yield a profit, has now proved a fairly remunerative branch of manufacture.

ON SOME BLOWPIPE REACTIONS.*

By E. J. CHAPMAN, Ph.D.,
Professor in University College, Toronto.

(Concluded from page 27).

VIII.—*On the Uselessness of Turner's Flux as Applied to the Detection of Boracic Acid.*

Many years ago—about 1827 or 1828—Turner proposed, in examining a body for the presence of boracic acid, to mix the test-substance with bisulphate of potash and fluor-spar (in the proportions of 4½ parts of the former to 1 part of the latter), and to expose the mixture on a clean platinum wire to the point of the blowpipe flame. Fluoboric acid is thus produced; and by its volatilisation, a momentary green colour is imparted to the edge of the flame. Merlet recommends the employment of 3 or 4 parts of this flux to 1 part of the substance under examination. This test is much quoted in blowpipe books and works on chemical analysis generally; but it is altogether superfluous. With borate of soda it fails entirely, or yields very unsatisfactory results; and although it answers for most other borates and for boro-silicates, it is uselessly applied to them, because these bodies colour the flame equally well, *per se*. Berzelius seems strangely to have overlooked the colouration of the flame as produced by many substances under blowpipe treatment. In his work on the blowpipe, for example, he fails to notice the character in describing the reactions of lepidolite, sulphate of baryta, datolite, triphylline, and other minerals, which exhibit it most distinctly. Under axinite, moreover, he has the following statement:—"Turner asserts that a flame tinged green by boracic acid is obtained by the aid of sulphate of ammonia (or bisulphate of potash) and fluor-spar." This "assertion" is true enough; but *all specimens of axinite colour the flame green, per se*. The uselessness of the flux was pointed out, I find, by Buzengeiger as long ago as 1829. In the *Annales des Mines* for that year (tome v., p. 36), he states: "J'ai essayé, pour reconnaître la présence de l'acide borique, d'employer le flux indiqué par M. Turner, mais ces tentatives ne m'ont pas réussi, probablement par défaut d'habitude. Quoi qui en soit, tous les mineraux que M. Turner a vu colorer la flamme en vert en les melant avec son flux, m'ont donné la meme réaction en les introduisant avec quelque soin dans la flamme bleue, sans les mèlanger avec aucun réactif." Buzengeiger, whose name does not seem to be quoted in any blowpipe work, appears to have first proposed the sloping blowpipe wick, long before it was adopted by Plattner; and he noticed, at the same early date, that the crimson colouration of the strontium flame was entirely obliterated by the presence of barytic compounds.

IX.—*On the Comportment of Certain Alloys under the Action of the Blowpipe.*

In examining these reactions, about equal portions of the metals (forming the alloy) may be placed together, on charcoal, and subjected to the action of a reducing flame.

1. *Platinum and Tin* unite with violent deflagration and emission of light, forming a hard, brittle, and infusible globule.

2. *Platinum, Zinc, and Tin* unite with violent action, the zinc throwing off long flakes of oxide.

3. *Platinum and Zinc, per se*, do not combine, the zinc burning into oxide.

4. *Platinum and Lead* unite quietly, forming a brittle globule.

5. *Platinum and Thallium* unite quietly; the resulting globule is dark externally, gray internally, and quite brittle.

6. *Platinum and Bismuth* unite quietly, or with merely slight spitting, into a dark brittle globule.

7. *Platinum and Copper* combine quietly, though not very readily, into a hard, light-coloured, malleable globule.

8. *Platinum and Silver* unite quietly, but not very readily unless the silver be greatly in excess, into a white malleable globule.

9. *Platinum and Gold* unite quietly, forming (if the gold be somewhat in excess) a yellow malleable globule.

10. *Gold and Tin* unite quietly into a very brittle globule.

11. *Gold and Zinc* do not combine *per se*; the zinc burns into oxide.

12. *Gold and Lead* combine quietly, forming a grey brittle bead.

13. *Gold and Thallium* unite quietly, but separate again to some extent during cooling. The globule may thus frequently be flattened out, but not without cracking at the sides. If the metals remain united, the button is dark blackish grey, and quite brittle.

* Communicated by the Author.

14. *Gold and Bismuth* unite quietly and readily, forming a very brittle globule.

15. *Gold and Copper*, and 16, *Gold and Silver*, unite, and form a malleable globule.

17. *Silver and Tin* unite quietly into a malleable globule.

18. *Silver and Lead* unite readily into a malleable globule.

19. *Silver and Thallium* combine readily; globule, malleable.

20. *Silver and Bismuth* unite readily and quietly; the globule is brittle, but admits of being slightly flattened out.

21. *Silver and Copper*, and 22, *Silver and Gold*, form malleable globules. The gold alloy, even with gold largely in excess, is quite white. If it be flattened out, and heated in a platinum spoon with some bisulphate of potash, it will become yellow from the silver on the surface being dissolved. On re-melting the flattened disc, a silver-white globule is again obtained.

23. *Copper and Tin* unite into a grey and partially malleable bead, the surface of which, in the O.F., becomes more or less thickly encrusted with cauliflower-like excrescences of oxide.

24. *Copper and Zinc* do not quite *per se* into a globule, the zinc burning into oxide. Under carb.-soda, or carb.-soda and borax, brass is readily formed.

25. *Copper and Lead* form a dark grey globule, which is sufficiently malleable to admit of being extended on the anvil.

26. *Copper and Thallium* melt into a dark grey malleable globule.

27. *Lead and Tin* unite readily, but the globule commences immediately to oxidise, throwing out excrescences of white and yellow oxide. On removal from the flame it still continues in ignition, and pushes out further excrescences. The unoxidised internal portion (if any remain) is malleable.

28. *Lead and Bismuth* unite readily; the molten globule acquires a thin dark coating of oxide on the surface only, and admits of being flattened out, more or less upon the anvil.

29. *Lead and Thallium* form a malleable globule.

30. *Bismuth and Tin* unite readily, but the fused mass immediately throws out excrescences, and becomes covered with a dense crust of oxides. The reaction, however, is not so striking as with lead and tin.

31. *Thallium and Tin* exhibit the same reaction as lead and tin, but the cauliflower-like excrescences are brownish black.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 18th, 1877.

Professor ODLING, F.R.S., Vice-President, in the Chair.

AFTER the names of the visitors had been announced and the minutes of the previous meeting read and confirmed, the following names were read for the first time:—Messrs. Michael Conroy, A. Pearson Luff, A. W. Glover, J. Angell, J. Bardsley, and M. Algernon Adams. Messrs. William Hampton, John Comyns Leach, and the Rev. D. W. Ladley were balotted for and duly elected after their names had been read the third time.

The first paper, by Dr. E. JÆGER, "*On some Derivatives of Dithymyl-trichlorethane*," was read by the SECRETARY. The author prepares the substance by the action of sulphuric acid diluted with one-third its volume of acetic acid in a mixture of chloral (1 mol.) and thymol (2 mols.). It forms colourless monoclinic crystals, melting at 198°, and by the action of oxidising agents is converted into thymoquinone. Dithymyl-trichlorethane,—

$$CCl_3.CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH\end{matrix}$$

when heated with zinc dust yields *dithymylethane*,—

$$CH_3.CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH\end{matrix}$$

and *dithymylethane*,—

$$CH_2=CH<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.OH,\end{matrix}$$

the former crystallising in flat plates, which melt at 180° and the latter in needles melting at 170°. By the action of feeble oxidising agents the latter yields a green crystalline compound, *dithymyl-quin-hydronethene*,—

$$CH_2=C<\begin{matrix}C_{10}H_{12}.OH\\C_{10}H_{12}.O\end{matrix}\quad\begin{matrix}OH.H_{12}C_{10}\\OH_{12}C_{10}\end{matrix}>C=H_2C,$$

which, by the further action of the oxidising agent is transformed into a red substance *dithymyl-quinone-ethane*,

$$CH_2=C<\begin{matrix}C_{10}H_{12}O\\C_{10}H_{12}O\end{matrix}>$$

These are related to one another and to the parent hydrocarbon in the same way that green quin-hydrone and quinone are related to hydro-quinone.

The CHAIRMAN said the Fellows were much indebted to the author for introducing to their notice these complex compounds related so nearly to the quinones.

Dr. ARMSTRONG said the experiments of Dr. Jäger possessed considerable interest, and although he agreed with him as to the formula he had assigned to the quinone, he could not say as much for that attributed to the green crystals, for it must be remembered that in the formation of green quinhydrone 3 molecules of quinone took part, and not 2, so that it was highly probable that the author's green compound should be represented as derived from 3 molecules of quinone and not 2 only.

The next paper, "*A Preliminary Account of Some New Reactions in Organic Chemistry and their Ultimate Bearings*," by Mr. C. T. KINGZETT and Dr. H. W. HAKE, was read by the former. After referring to the colour reaction known as the "Pettenkofer reaction," produced by the action of strong sulphuric acid on a mixture of sugar and cholic acid and some other substances, as glycocholic, hyocholic, oleic, and lithofellic acids, &c., and various compounds occurring in brain substance, the authors state that they have found that many other bodies behave in a similar manner, as benzene, phenol, turpentine, camphor, salicylic acid, pyrogallol, piperin, morphine, clove, and other essential oils, and various fatty bodies. Camphor dissolves in concentrated sulphuric acid, forming a deep red solution, and this, when mixed with cane-sugar syrup, solidifies to a rose-coloured paste; but on adding water the colour is destroyed, and an almost colourless precipitate produced, which is soluble in ether. When treated with sulphuric acid it now gives the colour reaction without the addition of sugar, although even when boiled for several hours with dilute sulphuric acid no sugar could be detected in the solution; so that this substance differs in a marked manner from the ordinary glucosides. From a comparison of the reactions yielded with the Pettenkofer test by benzene, benzoic acid, and phenol on the one hand, and turpentine, camphoric acid, and camphor on the other, the authors are of opinion that camphor stands in a somewhat similar relation to turpentine that phenol does to benzene, that camphor indeed may be the phenol of turpentine and not a ketone as ordinarily supposed. The authors concluded with some observations on the ultimate bearings of these new reactions, which they consider to cover a very wide field; leading, for instance, to the question of the general constitution of sugars and similar problems. Some of the reactions mentioned in the paper were exhibited.

Dr. ODLING having thanked the authors for their interesting paper, Mr. C. E. GROVES asked whether they considered the new compound obtained with the camphor

solution and sugar to be of the nature of a glucoside, and whether the cane-sugar which they employed was converted into glucose during the reaction.

Mr. KINGZETT replied that from the difference observed when such bodies as mannite were substituted for sugar in the reaction, he considered it probable that glucose might be formed. The compound, however, was not an ordinary glucoside or saccharide, as it was not decomposed by boiling with dilute acids; he believed, however, it would prove to be of the nature of a substitution derivative of a hexatomic alcohol, $C_6H_6(OH)_6$, in which one or more OH groups were replaced.

Dr. ARMSTRONG said they were much indebted to the authors for bringing before their notice these interesting colour reactions, but he thought the facts adduced as yet did not justify the speculative conclusions which they had drawn, as, for instance, that the relation between camphor and turpentine was similar to that between phenol and benzene.

Mr. KINGZETT replied that, although he had not done so, he could give structural formulæ to illustrate his meaning, and proceeded to show how some of the brain substances were split up under the action of sulphuric acid when they gave this colour reaction. With regard to the relation between turpentine and camphor he considered there was strong evidence to prove that camphor, was a phenol, and comparatively little to show that it was a ketone. The relation was brought out distinctly on comparing the formula—

Benzene, C_6H_6	Turpentine, $CH_3.C_3H_7.C_6H_6$
Phenol, $C_6H_5.OH$	Camphor, $CH_3.C_3H_7.C_6H_5.OH$

Dr. WRIGHT remarked that, although one argument in favour of the hydroxyl nature of camphor was its behaviour with such reagents as zinc chloride and phosphorus pentasulphide, giving rise to cymene, yet, on the other hand, with phosphorus pentachloride it yielded dichlorinated derivatives, which was not in accordance with the ordinary behaviour of alcohols under similar circumstances.

The next paper, on "*Dinitroso-orcin and Dinitro-orcin*," by Dr. J. STENHOUSE, F.R.S., and Mr. C. E. GROVES, was read by the latter, an abstract of which will be found in another part of the journal.

The CHAIRMAN having thanked the authors,

The SECRETARY read a paper, by Dr. T. CARNELLEY, "*On High Melting-Points, with Special Reference to those of Metallic Salts, Part* III." The author has determined the "time-values" of nine standard salts by comparing the time of melting with that of sulphur; the times of melting of the different salts always bearing a constant ratio to one another and to sulphur, and this ratio is the time value for each given salt. By interpolation the author has constructed a table giving the melting-points corresponding to various time-values from 0 to 241.

After the CHAIRMAN had thanked the author in the name of the Fellows, he adjourned the meeting until Thursday, February 1, when there will be a paper by Dr. H. E. Armstrong, "On Kekulé's and Ladenburg's Benzene Symbols," and one "On the Formation of Coumaric, Cinnamic, and other Analogous Acids from the Aromatic Aldehyds," by Mr. W. H. Perkin.

PHYSICAL SOCIETY.

January 20th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a member of the Society:—A. G. Greenhill, M.A.

Dr. HUGGINS exhibited an enlarged view of a photograph, half an inch in length, of the spectrum of the star α-Lyræ, which he has recently taken in a manner similar to that in which the spectrum of Sirius has already been obtained. The first results were very unsatisfactory, in consequence of the clockwork being insufficient for maintaining the image of the star on the slit for a length of time. Mr. Grubb has, however, devised a secondary control apparatus, the employment of which renders it impossible for the error to exceed one-tenth of a second. In the spectroscope employed the prism was of Iceland spar, and the lenses of quartz. Dry plates were employed, and the necessary breadth was secured by slightly changing the position of the image instead of by the use of a cylindrical lens. Dr. Huggins has also been engaged in taking a series of photographs of the moon, and hopes to obtain some information in regard to the question of a lunar atmosphere of small extent. In the spectrum of α-Lyræ a line occurs corresponding with H in the solar spectrum, and several more refrangible ones which he is at present unable to explain.

Mr. LOCKYER considered the results which Mr. Huggins is obtaining to be of extreme importance, and he pointed out how he hopes a large series of photographs of stellar spectra will afford valuable information in regard to the constitution of certain substances now supposed to be elementary, such as calcium. Some time ago he communicated a paper to the Royal Society on the spectrum of this metal, and he considers that it is not a simple substance, but that the H lines are due to two elementary substances of which it is composed; and this supposition is confirmed by the fact that in the photograph exhibited by Dr. Huggins only one of the H lines is present,—that is, only one of the constituents of the metal calcium is present in the star α-Lyræ.

Mr. W. C. ROBERTS read a paper on the "*Artificial Production of Columnar Structure*." He gave an account of the several theories which have hitherto been given as accounting for this phenomenon and that of cross-jointing as observed in the Giant's Causeway, and he dwelt specially on the views of Mr. R. Mallet and Prof. James Thomson. He found, as the result of experiment, that when certain masses of clay and sand are heated to about 1300° C. they contract to about the same amount as a basalt does in passing from the molten to the solid state, and that beautiful columnar forms are produced. He had hoped, by accumulating a number of specimens, to have been able to establish a relation between the strains at the point of rupture and the dimensions of the hexagons; but in the small masses employed the strains were so numerous that it was impossible to apportion their influences. He had, however, obtained a number of specimens which possessed much interest.

Mr. LECKY referred to a very fine columnar cliff in the island of Bedness, in Valencia Harbour, which he has examined in the hope of finding cross-joints, but, although some breaks exist, there are none at all comparable to those in the north of Ireland.

Prof. GUTHRIE showed an arrangement he has recently devised, in the hope of making the mercurial as sensitive as the water barometer. It consists of an ordinary syphon barometer, in which the two vertical tubes are united by means of a long, uniform, horizontal tube, having a diameter considerably less than that of the main tubes. The instrument is filled in the same manner as the ordinary syphon barometer, except that a bubble of air or dilute acid is left in the narrow tube. For a given rise of pressure the absolute amount of mercury which passes from the shorter to the longer tube depends upon their diameters, and, as this is great in comparison with the tube uniting them, the motion of the bubble will be considerable in comparison with that of the summit of the mercurial column. In the instrument exhibited the horizontal tube was formed into a spiral, in order that the vertical tubes might be in close proximity.

He then exhibited a number of thin india-rubber balloons filled with water, which he has arranged with a view to illustrate the nature of jellies. When a jelly sets it is assumed that the solid matter collects in the form of cells containing liquid, which burst on the application of heat. By weighing at intervals one of these india-rubber bags, he

has found that evaporation takes place from its surface. Thus with a bag weighing initially 749·4 grms., there was a loss of 0·95 grm. in the course of twenty-four hours. He is also examining a bag filled with salt water, and immersed in water, in order to ascertain whether salt as well as water is capable of traversing the septum.

Lastly, Prof. Guthrie exhibited a large series of Chladni's rings rendered permanent on cardboard by pressure, in contact with the plate which had been caused to vibrate, in a copying-press. The sand and lycopodium were caused to adhere firmly by dilute gum.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

January 15th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

THE Council reported that the decennial Anniversary of the Society would be observed by the issuing of a complete Index to the *Berichte* for the first ten years.

Prof. C. LIEBERMANN stated that, in connection with Dr. BENZINGER, he had obtained a "*Mono-nitro-thymol*" which yielded, through the amido-compound, thymoquinon, and gave an experimental proof that the quinon group is formed from an hydoxyl group and a nitro group of dinitro-thymol.

F. TIEMANN and N. NAGAI described "*Homo-Vanillic Acid and Homo-Protocatechuic Acid.*" The former, $C_9H_{10}O_4$, was obtained along with vanillic acid, by the oxidation of a solution of acet-eugenol in acetic acid with potassium permanganate. It possesses a much greater solubility in water than vanillic acid, but otherwise has nearly the same properties. Treatment with hydrochloric acid yields CH_3Cl, and homo-protocatechuic acid, $C_6H_3(OH)_2CH_2COOH$. This acid is more stable and soluble than protocatechuic acid, gives also much brighter colour-reactions with a ferric solution, and by distillation of the calcium salt yields homo-pyrocatechin.

F. TIEMANN and A. HERZFELD read a paper "*On the Formation of Para-Cumanic Acid*," which was obtained from para-oxy-benzaldehyd.

H. VOGEL described "*The Spectroscopic Reactions of Purpurin.*" A solution of perfectly pure purpurin gives two prominent bands between D and E, and between B and F. The spectrum disappears at once upon the addition of a trace of lime. It was found that the presence of 0·000002 grm. of CaO in a litre of the solution was sufficient to cause this change. No effect was produced by the addition of BaO or SrO.

The Secretary read the following communications from non-resident members:—

S. BOGUSKY and N. KAJANDER, "*Rapidity of the Evolution of Carbonic Acid.*" Experiments were performed with Carrara marble and five acids—HNO_3, HBr, HCl, CH_2O_2, and $C_2H_4O_2$. The first three appeared to obey a fixed law, that the quantities of carbonic acid evolved in a unit of time are inversely proportional to the molecular weights of the acids. Formic acid and acetic acid did not show this regularity, apparently in consequence of a physical change in the surface of the marble.

A. CHRISTOMANOS, "*On the Analysis of Chrome-Iron Ore.*" The author recommends a calcination of the roughly powdered ore before the final pulverisation, and suggests some changes in the method of carrying out the analysis.

A. BASAROW, "*On a Lecture-Experiment illustrating the Explosive Character of Certain Substances.*"

F. FREHRICHS, "*A New Method of Organic Analysis.*" The essential features consist in combustion with oxide of mercury, absorption of the water by phosphoric anhydride, and use of the air-pump.

A. LADENBURG, "*On the Constitutional Formula of Oxy-thymo-quinon.*"

A. LADENBURG and O. STRUVE, "*On the Quantivalence of Nitrogen.*" The authors defend the trivalence of this element from the comparison of the two compounds $N(C_2H_5)_3.C_7H_7I$ and $N(C_2H_5)_2(C_7H_7)C_2H_5I$.

R. ANSCHÜTZ and G. SCHULTZ, "*On Phenanthren.*" The authors give directions for the preparation of phenanthren and its quinon. By the action of NH_3 upon the latter, the compound $C_{14}H_9NO+H_2O$ was obtained.

H. SAUBERLICH, "*On the Action of Sulphuric Acid upon Tri-oxy-benzoic Acid and Benzoic Acid.*" The result is a quinon, $C_{14}H_8O_5$, forming crystals with a metallic lustre.

A. BENUTHSEN, "*On Sulph-acetamid.*" Colourless crystals obtained by the action of sulphuretted hydrogen on aceto-nitrile, melting at 108°. Prof. Hofmann called attention to the fact that numerous investigators had sought in vain to obtain this compound.

The following communications were received by the Secretary before the close of December, and appear in the *Berichte* for 1876:—

E. ELSASSER, "*On Electrolytic Action with Evolution of Hydrogen at Both Poles.*" This occurs when a platinum-magnesium element is immersed in very dilute sulphuric acid, or when the two metals in a solution of $MgSO_4$ serve as poles for a battery, the magnesium forming the anode. In both cases exactly half as much hydrogen is liberated on the anode as on the cathode.

C. BÖTTINGER, "*On the Acids posssesing the Formula* $C_5H_6O_4$." These three acids—citra-, ita-, and meta-conic acids—all yield, by reduction with zinc-dust, ordinary pyro-tartaric acid, ita-conic acid showing the most resistance to the reaction. Citra-conic acid was obtained as a by-product in the preparation of pyro-tartaric acid from pyro-racemic acid.

A. LAUBERHEIMER, "*On Ortho-dinitro Compounds.*" The author shows that the dinitro-chloro-benzene previously obtained by him is a meta-para compound in regard to the Cl atom, by changing it into chloro-nitraniline. His experiments would also prove that all ortho-dinitro compounds yield sodium-nitrite and a phenol by treatment with sodium hydrate, and ammonium-nitrite with the corresponding amide by treatment with alcoholic ammonia.

E. GLATZEL, "*Somé New Compounds of Titanium, and Experiments on the Solution of the Metal in Acids.*" Solution of the metal in HCl gave $Ti_2Cl_6+8H_2O$; in H_2SO_4 the corresponding sulphate, $Ti_2S_3O_{12}+8H_2O$, laminated cryssals yielding bright blue solutions. Nitric acid changes this sulphate into TiS_2O8+3H_2O—a yellow, resinous, exceedingly hygroscopic body. Titanium fluoride, $TiFl_4$, was obtained by solution in hydrofluoric acid, but always in company with small amounts of TiO_2. The reactions of $Ti_2S_3O_{12}$ with solvents are so similar to those of the so-called titanate of iron that the author regards this mineral as consisting of isomorphic mixtures of Ti_2O_3 and Fe_2O_3. In the dioxide compounds Ti stands between Sn and Si; in the sesquioxide compounds it belongs to the group of Fe, Al, Mn, and Cr, showing the most resemblance to iron.

E. ERLENMAYER, "*Extraction of the so-called Soluble Phosphoric Acid from Superphosphates.*" The author finds that acid phosphate of lime, $CaH_4(PO_4)_2+H_2O$, requires 700 parts of water for perfect solution, and that with a smaller amount of water a certain quantity of the salt is changed into free phosphoric acid, and insoluble $CaHPO_4+(H_2O)_2$. Mösker's process of extracting the phosphoric acid on the filter is therefore only to be used with superphosphates containing sufficient free acid to prevent this decomposition; otherwise as much as 8 per cent of the acid present passes over into the insoluble salt. Superphosphates containing no free acid yield correct results if digested with an amount of water at least 700 times the weight of the acid phosphate present.

"*A Simple Preparation of Alkaline Cyanides.*" Fusion of sodium with anhydrous ferrocyanide of pot yields a colourless fluid mass, easily poured off metallic iron, and becoming con

It contains 40 per cent of cyanogen in combination with the alkaline metals.

$C_{12}N_{12}Fe_2K_8 + Na_4 = (CyK)_8 + (CyNa)_4 + Fe_2$. "*Preparation of Normal Valerianic Acid from Normal Caproic Acid.*" The latter is changed by Br into a bromo-caproic acid, then treated with H_2SO_4, oxidised with a solution of chromic acid, and finally distilled. The distillate contains valerianic acid.

E. Fischer, "*Aromatic Hydrazin Compounds.*" Diphenyl-nitrosamine yields by reduction diphenyl-hydrazin, $(C_6H_5)_2N-NH_2$. It is isomeric with hydrazo-benzene, but the reactions of the two are strikingly unlike.

F. von Lepel, "*Spectral-Analytical Reactions for Salts of Magnesia.*" The presence of magnesia salts in solution modifies so characteristically the absorption-bands in the spectrum of purpurin that a solution of the latter can be used to detect the presence of a fraction of a milligrm. of a magnesia compound, even in company with the salts of the alkalies and alkaline earths.

H. Limpricht, "*Action of Bromine on the Silver Salts of Benzene Sulphonic Acids.*" $C_6H_5SO_3Ag$ gives, with bromine, meta-bromo-benzene-sulphonic acid. The silver salts of ortho-, meta-, and para-bromo-benzene-sulphonic acid, give with the same treatment various dibromo-sulphonic acids, from which tribromo-benzene-sulphonic acid is obtained by the same process. Nitro-benzene-sulphonic acid yields no results. The amido-benzene-sulphonic acids show a variety of complicated decompositions. On account of the properties, salts, and reactions of nitro-meta-bromo-benzene, sulphonic acid follows.

I. Remsen, "*On Phosphoric Oxychloride.*" This is easily produced by the action of ozone on the trichloride.

H. Beckurts and R. Otto, "*On α-Dichloro-Propionic Acid.*" This acid, $CH_3.CCl_2.COOH$, is obtained from α-dichloro-propionitrile by treatment with H_2SO_4; boils at 190°; gives, with reducing agents, propionic acid; and with Ag_2O, acetate and carb-acet-oxylate of silver.

J. H. van 't Hoff, "*On Benzene Formulæ.*" Kekulé's hexagonal formula is defended against the proposed prism of Ladenburg.

H. Schröder, "*On a Surprising Regularity in the Volume Relations of Certain Series of Compounds.*" The author has found, from numerous experiments, that the specific volumes of the various members of a series of compounds almost invariably stand in simple arithmetical relations to the specific volume of the common element or component, which not only imparts to the series its characteristic chemical behaviour, but also exerts a dominant influence on the volumes of the different compounds. For example, Ag possesses the sp. vol. 10·28; Ag_2O gives $30·8 = 3 \times 10·28$; Ag_2I_2 gives $82·2 = 8 \times 10·28$; $C_2H_3O_2Ag$ gives $51·4 = 5 \times 10·28$; pyrargyrite, $3Ag_2S + Sb_2S_3$, gives $185 = 18 \times 10·28$. Si possesses the sp. vol. 11·3; quartz, SiO_2, gives $22·6 = 2 \times 11·3$; diathen, $Al_2O_3.SiO_2$, gives $45·2 = 4 \times 11·3$; &c.

H. Klinger, "*On Thialdehyds.*" The author corrects erroneous statements with regard to the formation of thi-acetaldehyd, and describes a third isomeric, thiobenzaldehyd, obtained from benzoic aldehyd by the action of SH_2.

E. Berglund, "*Amido-sulphonic Acid.*" The author obtains it in the form of the Ba salt, by boiling barium imido-sulphonate with water and boric hydrate:— $R_2.O_2.(SO_2)_2NH + 2H_2O = R_2.O_2.SO_2 + H_4N.O.SO_2.OH$.

A. Aronheim, "*Action of Stannic Chloride upon Benzene.*" The vapours of the two bodies passed through a heated tube give $SnCl_2$, HCl, and $(C_6H_5)_2$, with no traces of an organic compound of tin. The process can be used for the preparation of diphenyl.

W. Michler and C. Dupertius, "*Synthesis of the Ketones derived from Dimethyl-Aniline.*" Dimethyl-aniline, upon treatment with $COCl_2$, yields, according to the temperature, hexamethyl-triamido-dibenzoyl-benzene, and tetramethyl-diamido-benzophenon. The latter is reduced with sodium-amalgam to the corresponding benzhydrol, the perfectly colourless crystals of which possess the remarkable property of imparting an intense blue to colourless solvents—as ether, alcohol, and acetic acid. Benzoyl-chloride and dimethyl-aniline yield dimethyl-amido-dibenzoyl-benzene, large well-formed crystals melting at 55°.

E. Mulder, "*On β-Amido-propionic Acid and β-Guanido-propionic Acid.*" Improvements on the method of preparing β-amido-propionic acid from glycerin, and theoretical considerations with regard to the formula of β-guanidopropionic acid.

H. W. Vogel, "*Methods for Detecting the Adulteration of Wines.*" The author compares the methods at present in use, and proposes the use of the spectroscope for this purpose, adding the results of a variety of experiments. The presence of fuchsine is shown by its characteristic absorption-band between D and E. *Ligustrum vulgaris* gives bands at D and F. The colouring-matter of mallow-leaves is also easily detected in the same way.

W. Michler and A. Gradmann, "*Synthesis of Organic Acids and Ketones by means of Carbonyl-Chloride.*" Diethyl-aniline gives, by treatment with $COCl_2$, diethyl-amido-benzoic acid, $(C_2H_5)_2N.C_4H_4.COOH$; and the chloride of this acid, by further treatment with diethyl-aniline, yields hexo-ethyl-triamido-dibenzoyl-benzene, and tetra-ethyl-diamido-benzophenon.

A. Claus, "*On Melamine Sulpho-Cyanate.*" This compound, $C_3H_6H_6.CNSH$, is obtained by heating $NH_3.CNSH$ at 250°; prismatic yellow crystals.

"*On a New Method of Preparing Stearic Acid.*" Ricinoleic acid, $C_{13}H_{34}O_3$, gives, with HI *in statu nascendi*, iodo-stearidic acid, $C_{18}H_{33}IO_2$, a yellowish oil, and this upon reduction with zinc yields stearic acid.

O. Doebner and W. Stackmann, "*Action of Benzo-Trichloride on Phenol.*" The result is benzoyl-phenol, $C_6H_5CO.C_6H_4OH$, analogous to the synthesis of salicylic aldehyd with $CHCl_3$.

H. Landolt describes the details of his arrangements for illustrating, by means of the magic lantern, various chemical reactions, such as the development of coloured vapours, liquefaction of gases, sublimation, crystallisation, &c.

S. Stein advocates the use of rock crystal for scale-beams, thermometers, normal weights, and measures of length.

W. Thörner describes a simple apparatus for fractional distillation in a partial vacuum.

C. Bulk describes an alteration in the construction of the ordinary filter-pump, by means of which the water-power can be used to produce also a forcible stream of air, and gives an account of a new separatory funnel, more easily regulated than those at present in use.

NOTICES OF BOOKS.

Chemical and Physical Researches. By Thomas Graham D.C.L., F.R.S., &c. Collected and printed for presentation only. Preface and Analytical Contents by Dr. R. Angus Smith. Edinburgh: 1876.

Thomas Graham's faithful friends, Dr. Angus Smith and Mr. James Young, could hardly have erected a more fitting and lasting monument to his memory than by reprinting in a collected form his various papers and researches, hitherto scattered through a number of *Transactions* of learned societies and scientific journals, many of which are long since dead and forgotten, while others are not to be obtained in libraries out of England. The papers are forty-six in number, the first being his researches on "The Absorption of Gases by Liquids," contributed to the *Annals of Philosophy*, in 1826, when the writer was still nearly a year under age, and ending with his famous memoir on "The Relation of Hydrogen to Palladium, and on Hydrogenium," first published in the *Proceedings of*

the Royal Society in January, 1869, the series thus extending over a period of forty-five years.

Thomas Graham was born in Glasgow in December, 1805; studied chemistry under Dr. Hope, of Edinburgh; took his M.A. degree at Glasgow University in 1826; and was made Lecturer to the Andersonian Institution in 1830, In 1837 he was made Professor of Chemistry at the London University, and in 1855 succeeded Sir John Herschel as Master of the Mint, a post he retained until his death in September, 1869.

His working life, as far as published researches go, may be said to begin with his paper on "The Absorption of Gases by Liquids," published in the early part of 1826. The young chemist seems to have been singularly struck with Faraday's experiments on the liquefaction of gases, and the boldness with which he asserts that gases ought to be regarded merely as volatilised liquids, and that in solution they exist in the liquid form, must have startled some of the more conservative of the chemists and physicists of half a century ago. In this article there is a fine piece of analogical reasoning, which augurs well for the boy chemist's future powers. "There is nothing," he says, "impossible or even surprising in the fact of water at 60° F. absorbing ammonia, muriatic acid, or sulphurous acid, and thereby converting them into liquids, when we consider that concentrated sulphuric acid heated to 600° F. will absorb and convert into liquid the vapour of water heated to the same degree; that is to say, nearly 400° F. above its vapourising-point." This, we believe, was the first time that the analogy between gases and vapours was so clearly and strikingly enunciated. The coolly satirical manner, too, in which he speaks of *reputed* liquids and gases must have been a sore trial to the temper and the nerves of the orthodox of that day. It is interesting to compare these bold generalisations with his speculations with regard to the passage of hydrogen through palladium as being the result of "the solution of liquid hydrogen in the colloid metal" (p. 290), and with the almost absolute certitude with which he gives the specific gravity of solid hydrogen, and insists on its being a white metal possessed of ductility and tenacity, capable of conducting heat and electricity, and even possessing magnetic powers, in the very last research he ever published. It is a curious psychological phenomenon to find the same mind applying itself at the dawn as well as at the sunset of life to the selfsame task—the breaking down of the barriers between gases, liquids, and solids.

Passing over several papers on "Nitrification" and other subjects, we come to his first researches on the diffusion of gases through each other, published in the *Quarterly Journal of Science* in 1829. In this paper he describes minutely his first experiments on the spontaneous movement of gases, a subject which he afterwards pursued with such brilliant results up to the very end of his career. In this paper he consistently treats the vapours of water and alcohol as gases. This paper is followed by one on the bursting of a bladder half-filled with coal-gas in an atmosphere of carbonic acid, an experiment which seems to have led to his employing colloid septa in most of his subsequent researches. For the next two years he published but little, and apparently employed the interval in prosecuting his experiments on gas diffusion, and in deducing laws from the phenomena he observed. In 1831 he read his great paper "On the Law of the Diffusion of Gases" before the Royal Society of Edinburgh. Graham seems to have been first induced to experiment in this direction by an observation of Döbereiner's, who found that hydrogen standing over water in a fissured bell-jar escaped so rapidly that the water gradually rose to several inches above the level of the trough. Graham apparently began his experiments with fissured vessels, but soon abandoned them for Wedgwood tubes and plaster-of-Paris plugs. The enunciation of the law that the velocity of diffusion of gases is in inverse proportion to the square root of their density was the most important result which Graham had yet obtained, and gained for him the Keith Prize before he had completed his twenty-fifth year. In this paper, too, we have the first speculation as to the part played by the laws of gas diffusion in regulating certain physiological functions. The continuous distension of the tubulæ of the lungs and of the respiratory system of insects is accounted for by the greater velocity with which oxygen passes inwards through the colloid septa forming their walls as compared with the passage of the carbonic acid outwards. In this paper, also, we first perceive the earliest glimpse of his belief as an atomist:—"My experiments . . ." he says, "afford the first demonstration of the fact that diffusion takes place between the ultimate particles of gases, and not between sensible masses." He concludes by shooting a Parthian arrow at the inventors of more or less unfounded hypotheses by declaring that the law at which he has arrived is merely a description of phenomena, and involves nothing hypothetical.

Passing over a paper on "Phosphuretted Hydrogen," which shows an immense amount of that patient research which was one of his distinguishing characteristics, we come to one which was read before the British Association in 1845, "On a New Property of Gases," which gives an account of his experiments on the effusion of gases into a vacuum, a subject which was much more fully treated of in the following year in the *Philosophical Transactions*, in which the effusion of gases into a vacuum through perforated plates, and their transpiration through capillary tubes are described. These experiments, especially those on transpiration, presented numerous apparent anomalies, but the passage of gases through minute apertures into a vacuum appear to be governed by the general law similar to that regulating their diffusion. The second part of this paper appeared in the *Philosophical Transactions* for 1849, the experiments therein detailed showing that the laws of effusion through an orifice, and of transpiration through capillary tubes, are different, although velocities in the latter case bear a constant relation to each other. His next work on gases is on their molecular mobility, and was published in the *Philosophical Transactions* for 1863, his attention in the meantime having been devoted to other matters. In these experiments he used plates of Brockedon's compressed graphite, the pores of which are so exceedingly minute that they are impenetrable to a gas in mass. In this paper he joins Herapath in revising Dr. Bernoulli's hypothesis that a gas consists of solid and perfectly elastic spherical particles, which move in all directions, their velocity being different in different gases. The graphite plates enabled our philosopher to compare the laws of diffusion and transpiration with greater accuracy, showing more conclusively than before that they have no relation to each other. This paper also contained a large number of experiments on atmolysis, or the partial separation of mixed gases by diffusion into a vacuum. The tube atmolyser is also described, the diffusion tubes used being Dutch tobacco-pipe stems enclosed in glass tubes. The inter-diffusion of gases through large apertures likewise received considerable elucidation, the experiments showing that in perfectly still air its molecules spontaneously alter their position, and move to a distance of half a metre in any direction in the course of five or six minutes. This, we believe, is the first time that the correctness of the kinetic theory was placed beyond all reasonable doubt by actual measurement, and the connection between the convection by gases and their molecular movement made apparent. Three years after (in 1866) Graham published his researches on the "Absorption and Dialytic Separation of Gases by Colloid Septa," showing that, so to speak, liquids act as carriers of gases through such media, those gases which are the most soluble passing through the quickest. These researches appear to be the outcome of the experiment of the inflation and bursting of a bladder half-filled with coal-gas in an atmosphere of carbonic acid before alluded to, the media used being india-rubber, varnished silk, bladder, &c. The second part of this paper describes the action of metallic septa on gases at a red heat, in a series of researches instigated by those of H.

Sainte-Claire Deville and Troost, on the passage of gases through red-hot platinum and iron. In these experiments he showed that platinum at a red heat was more permeable to hydrogen even than caoutchouc at ordinary temperatures, other gases being almost entirely stopped. He also found that red-hot platinum not only transmitted hydrogen, but actually absorbed or *occluded* it, retaining it on cooling. But the prime discovery in this paper was that of the wonderful force possessed by palladium of occluding hydrogen, which was the first step towards his theory of hydrogen being a metal. He also demonstrated the colloid nature of platinum, palladium, and other metals by showing that osmium-iridium, being crystalline, was incapable of occluding hydrogen. He also proved that palladium occluded hydrogen, even at ordinary temperatures, and that it absorbed water, alcohol, oil, and other liquids to a certain extent. The courageous way in which Graham speaks of liquid hydrogen, and of its evaporation from the surface of palladium foil, reminds one of his boldness in breaking down the distinction between gases and liquids in his very first paper. His subsequent idea of the existence of hydrogen does not appear yet to have struck him, his first view being that hydrogen is occluded by palladium in a liquid form, the liquid gas differing little in its specific gravity from the hydrocarbons, and being excessively volatile. He also considers that in passing through the graphite plate of a diffusiometer hydrogen is at any rate partially liquefied. This paper was quickly followed by one on the occlusion of hydrogen by meteoric iron, proving that the Lenarto meteorite contained three times its volume of occluded hydrogen, and that it must hence have been extruded from a dense atmosphere of that gas. These researches were quickly followed by his famous paper on the "Relation of Hydrogen to Palladium, and on Hydrogenium," in which he announced his method of charging palladium with hydrogen by making the metal form the negative electrode of a voltaic battery. By this means he succeeded in making palladium absorb 936 times its volume of hydrogen, its density being diminished and its bulk increased. From various experiments he deduces the density of hydrogen in the solid metallic form, having apparently abandoned his hypothesis of a liquid. Other experiments showed that the compound of palladium and hydrogen was moderately magnetic, palladium being but feebly so. His reasoning on this subject is peculiarly close. The fact of gaseous hydrogen not being magnetic is no obstacle to his theory, for, as he justly observes, magnetism is liable to extinction by heat. He also claims for it the electric conductivity as well as the tenacity, ductility, and malleability of a metal.

So far, Graham's researches on gases, in comparison to his other labours, must be considered to be those on which his fame principally rests.

In his researches on salts and solutions we see the same leading idea always at work—the investigation of the atomic structure of matter. His discovery of the relations of the phosphates, and the modifications of phosphoric acid, did much to lay the foundations of the modern chemical theory of polybasicity, and his investigations into the part played by water as a constituent of salts threw a flood of light on many points which had long remained unaccounted for. His theory of the voltaic circle, too, was a most brilliant one, especially that portion which explained the apparent travelling of hydrogen and oxygen from one plate to another. In 1849 he first published an account of his experiments on the diffusion of liquids, which, although perhaps not so brilliant as those on gas diffusion, are none the less important in their way. As gas diffusion led to atmolysis, so liquid diffusion led to dialysis, and his division of liquids into two new classes, colloids and crystalloids, formed an era in the history of the molecular structure of bodies. He also applied his method of transformation through capillary tubes to liquids, but his patient and laborious work in this direction bore but little fruit. As a piece of speculative reasoning his paper on the constitution of matter will always be read with admiration. It appears in some sort to be a confession of faith on the part of the writer, who asserts his belief that various kinds of matter possess the same ultimate molecule in different conditions of movement, this universal mobility pervading all gaseous, liquid, and solid bodies. In this paper we cannot help being astonished at the boldness and closeness of the reasoning, although some may demur to the conclusions drawn therein, a remark that will apply with equal force to his views about hydrogenium. As Dr. Angus Smith remarks in his excellent preface, "Graham was a true descendant of the early Greeks, . . . and in all his works we find him steadily thinking on the ultimate composition of bodies."

Amongst his most prominent characteristics were his singular powers of interpreting the results of his investigations; his indomitable patience and industry in performing countless numbers of the most tedious experiments; his steady pursuit of a single object—the atomic constitution of matter; as well as the candid courage with which he announced his conclusions when once he found them justified by his experiments. The theories of his time had but little influence on him, and his researches were conducted independently of them, his conclusions being always drawn from work done by himself. His mind was singularly free from narrowness, and his speculations are distinguished by a breadth of view that places them far above the mushroom hypotheses that are constantly springing up.

An analytical table of the contents of each paper and a copious index will greatly facilitate the work of the student. Considering the general value of the book it seems a pity that it should have been printed for private circulation only.

Dr. Angus Smith's preface to this valuable work gives a succinct account of the atomic theory from Leucippus to the present day, as well as a general sketch of Graham's labours.

Dr. Angus Smith also gives in the preface the following complete, though short, summary of the "Heat and Kinetic Theory:"—

"We pass to the next important stage, namely, the motion of gaseous molecules, if not of atoms, and the beginning of the attempt to define it precisely. The first definite ideas are by D. Bernoulli. They are explained in his Hydrodynamics,* which, although published in Strasbourg in 1738, were previously worked at when he was Professor in St. Petersburg.

"D. Bernoulli says—'The chief peculiarities of fluids are these: 1st, they are heavy; 2nd, they expand in all directions unless they are confined; and, 3rd, they allow themselves to be compressed more and more, according to the increased force applied.' Speaking of a vessel of air with a weighted cover, and which he illustrates with a diagram, he says—'So the minute bodies, whilst they impinge on the cover E F, keep it up by their continually repeated strokes, and form an elastic fluid, which expands itself when the weight is removed or diminished.' 'We shall consider the corpuscles enclosed in the hollow of the cylinder as infinite in number, and when they occupy the space E C D F we shall say that they constitute the natural air.'

"Davy and Count Rumford entered the field when this theory of gaseous motion was forgotten, and inaugurated a new theory of heat founded on molecular activity. That heat is immaterial was no rare opinion last century, or since Lord Bacon spoke of it as *motus et nihil aliud*. However, atomic motion ceased from the time of Rumford to be a vague idea. Davy† spoke definitely when, without calling in the aid of forces, he supposed that in solids the particles are in a vibratory motion, the particles of the hottest bodies moving with greatest velocity and through the greatest space; that in fluids and elastic fluids, be-

* Danielis Bernoulli, Joh. Fil., Med. Prof. Basil. *Hydrodynamica, sive de viribus et motibus Fluidorum Commentarii* (Argentorati, 1738), p. 200.

† "Collected Works," vol. iv., p. 67.

sides the vibratory motion, which must be considered greatest in the last, the particles have a motion round their own axes with different velocities, the particles of elastic fluids moving with the greatest quickness; and that in ethereal substances the particles move round their own axes and separate from each other, penetrating in right lines through space. Temperature may be conceived to depend on the velocity of the vibrations, increase of capacity on the motion being performed in greater space, &c.

"This is evidently the work of Rumford and Bernoulli, with additions after passing later through an original and powerful mind.

"We may take the next step to Herapath.* At p. 15, vol. i., he says:—

"'*Theory of Gases.*—From these considerations it follows that if a number of small bodies be inclosed in any hollow body, and be continually impinging on one another and on the sides of the inclosing body; and if the motions of the bodies be conserved by an equivalent action on the sides of the containing body, then will these small bodies compose a medium, whose elastic force will be like that of air and other gaseous bodies; for if the bodies be exceedingly small, the medium might, like any aëriform body, be compressed into a very small space; and yet, if it had no other tendency than what would arise from the internal condition of its atoms, it would, if left to itself, extend to the occupation of a space of almost indefinite greatness. And its temperature remaining the same, its elasticity would also be greater when occupying a less, and less when occupying a greater space; from a compressed state the number of atoms striking against a given portion of the containing vessel must be augmented, and the space in which the atoms have to move being less, their motions or periods must be shorter, and the number of them in a given time consequently greater; on both of which accounts the elasticity is greater the greater the compression. Besides, when other things are the same, the elastic force augments with an augmentation of temperature and diminishes with a diminution; for an increase of temperature, according to our theory, must necessarily be attended with an increase of velocity, and therefore with an increase in the number of collisions.'

"Joule took up the subject immediately after Herapath, and says†—'Since the hypothesis of Herapath, in which it is assumed that the particles of a gas are constantly flying about in every direction with great velocity, the pressure of the gas being owing to the impact of the particles against any surface presented to them, is somewhat simpler. I shall employ it in the following remarks on the constitution of elastic fluids,' &c. Dr. Joule continued the subject, and introduced it into the region of experiment and observation, or, in other words, to the science of modern times.‡ Joule might have added that the view he adopted is not only in accordance with the known laws of the elasticity of gases, but conforms to the ratio of the specific heats of gases. The mathematical development continued to make progress in the hands of Clausius, Clerk Maxwell, Holtzman, and others, taking us to new fields, and outside the region of Graham's activity."

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The interesting and suggestive letter from Captain Marshall Hall, which appeared in the CHEMICAL NEWS, vol. xxxv., p. 19, deserves attentive consideration from all Fellows of the Chemical Society.

An opportunity seems now to be at hand for raising the Society to a place of distinction commensurate with the true value of chemical science. We see rising indications of a removal of the veil which has too long concealed these proportions. It begins at length to be apparent that the future place of nations will be determined by original research and not by exalted classical attainments.

When recently in the tomb of Agamemnon, at Mycenæ, were found the attenuated remains of a tall Trojan monarch with golden mask and diadem, chemical knowledge suggested an alcoholic solution of gum juniper by which the frail structure was preserved.—I am, &c.,

G. A. KEYWORTH.

Hastings, January 16, 1877.

STEEL ANALYSIS.

To the Editor of the Chemical News.

SIR,—The writer of the article "On the Estimation of Phosphorus by the Phospho-Ammonio-Molybdic Salt," &c., in the CHEMICAL NEWS (vol. xxxv., p. 1), and on the "Calculation of Chemically Combined Carbon," &c. (vol. xxxv., p. 17), while recommending "improvements," gives no proof of his statements any further than his own authority, and as I feel it my duty to protest against his deductions and methods of working, I may perhaps be permitted a little space in your journal to criticise the articles referred to.

With regard to the article on the "Estimation of Phosphorus," &c., he objects to Eggertz's method for three reasons. I may dismiss his first reason.

2. Because "a certain quantity of the yellow precipitate is dissolved and passes through the filter with the solution." If such is the case the objection applies equally to his own "improvement," as he must wash the yellow precipitate free from iron, or use citric or tartaric acid to prevent the iron from being precipitated.

3. "Because the precipitate is slightly soluble in acidulated water;" and, secondly, "because a small quantity of the acid always remains on the filter, from which the filter, when dried is always a little rotten."

With regard to the first part of this objection, it also applies to his own method, that is, assuming for the sake of the argument that it is an objection. The difficulty of the rottenness of the filter can easily be got over by simply washing the precipitate on to a small weighed capsule, evaporating to dryness, and weighing; a very common proceeding, and one which I think ought to suggest itself to anybody, and I scarcely think that Prof. Eggertz claims the weighing on the filter as an essential part of his process.

With regard to his "method" it has all his objections to the molybdate process, with none of its advantages. By using 1 grm. (as he recommends) of the iron or steel a very small precipitate is got, which renders the process quite unfit for determining small quantities of phosphorus. In a Bessemer steel, for example, containing 0·1 per cent P (rather a high percentage), the precipitate of $Mg_2P_2O_7$ would weigh 0·0039 grm., a fact which chemists who have such work to do will quite appreciate.

M. Kern also makes a mistake when he says that the ignited precipitate ($Mg_2P_2O_7$) contains 13·51 per cent P; I think 27·92 per cent is the proper figure.

With regard to his article on the "Calculation of the Percentage of Chemically Combined Carbon," &c., his whole improvement consists in diluting a solution of 0·1 grm. of a standard steel containing 0·31 per cent carbon to 8 c.c. (why 8 c.c. ?), and then explaining how the value of each c.c. is to be calculated. Thus—

$$\frac{0{\cdot}31}{8} = 0{\cdot}0038 \text{ per cent of carbon.}$$

—I am, &c.,

WILLIAM GALBRAITH, F.C.S.

Sheffield, January 16 1877.

* "Mathematical Physics," &c., by John Herapath. 2 vols., 8vo. 1847.

† *Memoirs of Lit. and Phil. Soc. of Manchester*, vol. iv., 1851, p. 111.

‡ See "Math. Physics," vol. i., p. 264.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 1, January 3, 1877.

Cause of the Movement of the Radiometer.—MM. Bertin and Garbe.—There has been a prolonged discussion on the question whether the disks of the radiometer revolve in virtue of the direct action of the calorific or luminous source, or if their movement was produced by the air enclosed in the apparatus. M. Schuster was the first who made the important remark that if the cause of the movement was internal the case, if suspended, ought to turn in a direction contrary to the disks, which he has indeed demonstrated. But Mr. Crookes having obtained a contrary result,* we wished to know the truth, and have therefore undertaken the experiments which we now describe to the Academy.

Efflux of Mercury from Capillary Tubes.—M. E. Villari.—The quantity of mercury which flows in a second of time is proportional to the pressure under which the efflux takes place, to the fourth power of the radius of the tubes, and inversely proportional to the length.

Rotatory Power of Mannite and its Derivatives.—M. G. Bouchardat.—The author finds that mannite possesses a specific rotatory power, which is augmented whenever mannite enters into a composition, such as the formation of ethers, or when it is dissolved in water charged with boracic acid, borax, caustic soda, and some other salts.

Researches on Melezitose.—M. A. Villiers.—Not suitable for abstraction.

No. 2, January 8, 1877.

Does Ozone Combine with Free Nitrogen in Presence of Alkalies to form Nitrous Compounds and Nitrates?—M. Berthelot.—The view that ozone combines with free nitrogen at ordinary temperatures, in presence of alkalies, forming nitrous compounds, is very generally maintained, on the authority of Schœnbein ("Deukschrift über das Ozon," p. 16; Basle, October, 1849), and is considered as one of the principal sources of natural nitrification. M. Berthelot has verified the observations of Schœnbein on the formation of nitrous compounds during the slow oxidation of phosphorus in contact with the air, but he has not succeeded in proving the oxidation of free nitrogen by ozone in presence of alkalies.

Decomposition of Urine, with reference to the Recent Communications of Dr. Bastian.—MM. Pasteur and Joubert.—A continuation of the controversy on abiogenesis.

Observations on the Internal Structure of one of the Masses of Native Iron from Ovifak.—M. Daubrée.—The author considers it still doubtful whether the native iron of Ovifak is of a cosmic or of a terrestrial character.

Determination of the Polar Distance in Magnets.—M. R. Benoit.—A mathematical paper, incapable of useful abridgment.

Experiments on the Coagulation of Fibrin.—M. A. Schmidt.—The coagulation of fibrin in certain liquids of the animal economy is due to the presence of an albuminoid substance, which, from a chemical point of view, closely approaches the fibrino-plastic substance.

Effects of Heat on Voltaic Circuits completed by an Electrolyte.—M. W. Hellesen.—Not suited for abstraction.

* This is an error. Mr. Crookes's experiment on the rotation of the glass case of a magnetic radiometer, described to the Royal Society, March 30, 1876, corroborated Dr. Schuster's views.

Action of Sulphate of Lime on the Alkaline Sulphates.—M. A. Ditte.—The sulphate of lime combines with the sulphates of potassa and of rubidium, forming double salts. With the sulphate of soda a similar double salt is formed on more prolonged contact, whilst with the sulphates of soda, lithia, magnesia, and thallium no double salts are formed, even after contact prolonged for several months.

Camphor of Patchouli.—M. J. de Montgolfier.—This compound has the composition indicated by the formula $C_{30}H_{26}O_2$, and is therefore an isomer of the camphor of cubebs, and belongs to the type of the hydrates derived from the carbides, $(C_{10}H_8)\ n$.

Reimann's Farber Zeitung. No. 42, 1876.

A new colour has been introduced into the market under the name of napolin or nopalin. Some of the samples are said to consist of eosin, and others of a cochineal.

The Indian (Japanese?)dressing for textile materials known as Hai Thao is sold now in Paris at 6½ francs per kilo.

There is an article by M. Glanzmann (*Bull. de la Soc. Ind. de Rouen*) on the patent colours of Croissant and Bretonnière, which are now also manufactured by Poirrier and Co. under the name of Cachou de Laval. For printing purposes these colours are not well adapted. In dyeing, to obtain a certain tone it is requisite not merely to use the same weight of colour to the same quantity of goods, but to keep the dye-bath always at the same degree of concentration. Darker shades are obtained when the goods, after dyeing, are passed through dilute nitric acid instead of through chromate of potassa.

NOTES AND QUERIES.

Tetrachloride of Carbon.—How is the tetrachloride of carbon made, and for what is it used. I notice by your advertising columns that this substance is largely advertised, and I infer that its production must be considerable. It cannot be made like the other chlorides of carbon, by the action of sunlight on chloric ether or other analogous substances, as the process would be too slow and too expensive. I think it must be made by the action of dry chlorine on incandescent coke, or in some such way. In the *Jahresbericht der Chemie* I find its formula, but not the method of preparation; the formula given is $(C.Cl_3)Cl$, or $(C.Cl_4)$. I saw a short time since in your columns an abstract of a patent specification, in which was specified the use of this substance to make non-drying oils dry in varnishes (which, by the way, I do not think possible); but that set me thinking about it. I inquired of the editors of the *Scientific American* (the only question I ever asked from them), and they could not answer. An answer through your columns will oblige.—C. (Dayton, U.S.A.).

Pig-Iron Containing Manganese.—Can any reader of the Chemical News favour me with the following information regarding the metallurgy of manganiferous pig-iron:—In smelting manganiferous iron-ore, is there any definite relation between the amount of manganese in the iron produced and the amount of Mn in the slag accompanying it, and if so what are the usual proportions? If a certain iron-ore containing no manganese yields 35 per cent Fe, and 45 per cent slag, what percentage of manganiferous hæmatite, containing about 10 per cent Mn and about 50 per cent Fe, must be added in order to produce a pig-iron containing 1 per cent manganese.—Ferro-Manganese.

Milk Analysis.—The examination of milk has become a matter of great importance to society, and chemists are continually called upon to report the relative amounts of butter and other constituents which this valuable article contains. The following method has been found to yield very reliable results for the determination of fat. A quantity of milk, from 10 to 12 grms., is weighed in a small porcelain basin, evaporated to dryness on a water-bath, and the residue very carefully transferred to a tube (closed at one end) of hard combustion glass, about 10 inches long, and ¾ of an inch in diameter. The basin is rinsed several times with ether, and poured into the tube, which is closed with a tightly fitting cork, and the thumb closely pressed upon it. The tube is then placed in water, the temperature of which is sufficiently high to raise the etherial solution to its boiling-point, and the contents are briskly shaken for a few minutes; when cool, the solution is filtered into a weighed platinum dish, and the residue again treated in a similar manner. I have found that after three treatments of this kind, not a trace of fat remains in the residue. The dish containing the solution is placed in warm water, and gently evaporated, finally transferred to a water-bath, and heated until weight remains constant. In four determinations of fat by the foregoing method 3·24, 3·23, 3·30, and 3·31 per cent respectively were obtained.—J. Snell.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 29th.—London Institution, 5.
—— Medical, 8.
TUESDAY, 30th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Anthropological Institute, 8
WEDNESDAY, 31st.—Society of Arts, 8. "Ventilation of Rooms generally, and the way to make Workmen's Cottages Comfortable, Warm, and Healthy," by Frank E. Thicke.
THURSDAY, Feb. 1st.—Royal, 8.30.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Royal Society Club, 6.30.
—— Chemical, 8. "On Kekulé's and Ladenburg's Benzene Symbols," by H. E. Armstrong. "On the Formation of Coumarin and of Cinnamic and other analogous Acids from the Aromatic Aldehyds," by W. H. Perkin.
FRIDAY, 2nd.—Royal Institution, 9. "Vortex Motion," by Prof. O. Reynolds..
Geologist's Association, 7.30. (Anniversary).
—— Society of Arts, 8. (Indian Section). "Indian Tea Cultivation; its Origin, Progress, and Prospects," by A. Burrell.
SATURDAY, 3rd.—Royal Institution, 3. "Florence and the Medici," by J. A. Symonds.
—— Physical, 3.

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THE CHEMICAL NEWS

Vol. XXXV. No. 897.

ON THE QUANTITATIVE DETERMINATION OF NITRIC ACID BY INDIGO.

By ROBERT WARINGTON.

The determination of nitric acid by means of a solution of indigo is a method possessing the great advantages of speed, simplicity of execution, and ability to measure extremely minute quantities of the substance sought. The method is already in constant use by several English chemists, and the recommendation of it in the new edition of Sutton's *Volumetric Analysis*, and especially the very satisfactory series of test experiments contributed by Mr. W. Thorp, will doubtless lead to an extensive trial of it by many chemists. As the method has recently been examined with some care in the Rothamsted Laboratory, it will perhaps save time and trouble to other investigators if a short account is given of the results obtained.

There are two somewhat distinct methods of employing indigo for the determination of nitric acid—that of Boussingault, in which hydrochloric acid is the medium of the reaction, and that originated by Marx, in which sulphuric acid is employed. Boussingault's method is given in full in his *Agronomie, Chimie agricole et physiologie*, ii., 244, published in 1862. As this work is probably inaccessible to many chemists, it will be well to commence with a brief account of Boussingault's method, more especially as no reference is made to it by Marx, or by any of the German writers following him.

In Boussingault's method 2 c.c. of the nitrate solution to be examined are placed in a test-tube, a drop or two of solution of indigo added, and then ½ c.c. of pure hydrochloric acid; the whole is then heated. As the colour of the indigo disappears more is added. When the colour ceases to fade, the liquid in the test-tube is concentrated by boiling. If concentration fails to destroy the blue or green colour, another ½ c.c. of hydrochloric acid is introduced. The reaction is completed when neither concentration, nor fresh addition of hydrochloric acid, destroys the excess of indigo present. The colour produced by a small excess of indigo is a bright sap-green: this tint is the final reaction sought. The small excess of indigo necessary to produce a green colour is deducted in every experiment.

It is evident that in Boussingault's method it is advisable to use as small a bulk of indigo solution as is consistent with an accurate determination of the quantity employed, the concentration in the test-tube will else become tedious. Boussingault employs three indigo solutions of decimal strengths: their values are determined by experiments with pure nitre.

The largest amount of nitric acid Boussingault deals with is about 0·016 grm.; the smallest quantity that can be distinctly determined is 0·00000054 grm. The error in a determination may apparently sometimes amount to 5 or 6 per cent of the nitrate present, but with proper care will generally be considerably less.

Boussingault early discovered that the presence of certain kinds of organic matter was fatal to the accuracy of the determination. If sugar, dextrin, or gelatin were present, the results found were far too low, the oxidising power of the nitric acid being exerted on these as well as on the indigo. On the other hand, citric, tartaric, acetic, and oxalic acid were without effect: ammonium salts, also, had no influence. The organic matter of rain-water had a marked effect, and nitrates intentionally added to rain-water could not be determined with accuracy, the result being far too low. Boussingault found that he could meet this difficulty by distilling the mixed nitrate and organic matter with bichromate of potassium and sulphuric acid, the distillate containing the whole of the nitric acid free from organic matter. Nitre mixed with ten times its weight of sugar was thus satisfactorily determined. With nitrogenous organic matter the bichromate did not succeed equally well, a part of the organic nitrogen being converted into nitric acid, and the result being consequently too high. Boussingault then tried distillation with peroxide of manganese and sulphuric acid. This plan gave good results in the presence of moderate amounts of organic matter, whether nitrogenous or not; but with large quantities of sugar the results were not so good as with bichromate. Distillation with peroxide of manganese and sulphuric acid was the method finally adopted by Boussingault. It is performed in a very small retort half-filled with broken glass. 1 grm. of the peroxide and 1 c.c. of oil of vitriol are introduced, with a few cubic centimetres of the nitrate solution; distillation is carried on till white fumes appear; 2 c.c. of water are then added to the contents of the retort, and distillation resumed: the rinsing with 2 c.c. of water is again repeated.

If chlorides are present, free chlorine would be produced during the distillation with manganese, and be reckoned as nitric acid in the titration with indigo. If chlorides are in considerable quantity they are to be removed before distillation, by treatment with silver, &c.; but if the amount is small they need not be removed: the distillate is in this case treated with a little ammonia, and brought to boiling for an instant; free chlorine is then immediately destroyed.

Such is Boussingault's method, which he has largely employed in his numerous investigations: it is used by several French chemists, but has not met with any general adoption.

The second indigo method is that originated by Marx, and published by him in 1868 (*Zeitschr. f. anal. Chem.*, vii., 412). He mixes the nitrate solution with twice its volume of oil of vitriol, and then quickly runs in a solution of indigo from a burette till a small excess of indigo is present. Numerous investigations of this method have appeared in Germany; the principal are by Trommsdorff, Goppelsroeder, and Bemmelen. A form of this method has been recently recommended by Sutton, as already mentioned. As this method promised greater speed and simplicity than that adopted by Boussingault, it is the one which has been lately examined at Rothamsted.

The amount of indigo that is oxidised by a nitrate mixed with oil of vitriol depends on a great variety of circumstances. Instead of describing what different investigators have said on this subject, it will be simpler to enumerate in order the various points brought out in the present series of experiments, and merely refer from time to time to the statements of other observers.

In all the following experiments the indigo employed was a filtered solution of so-called "indigo-carmine." The nitre solution was of the strength recommended by Sutton (10 c.c. = 0·01011 grm. KNO_3), unless the contrary is stated: 10 c.c. of this solution was the volume used in each experiment. The oil of vitriol was pure distilled acid.

I. *The maximum amount of Indigo is consumed only when a sufficiency of Indigo is present with the Nitrate before the addition of Oil of Vitriol.*

If a nitrate solution is treated with a proper volume of oil of vitriol, and indigo immediately run in from a burette till an excess is present, and a second experiment be afterwards made in which the nitrate solution and the measure of indigo just consumed are first mixed, and the same volume of oil of vitriol added as before, it will be found that the indigo is now quite insufficient, though all the volumes remain the same as in the first experiment. When, by successive trials, the maximum amount of

indigo oxidisable by the nitrate has been ascertained, it will be found far larger than that shown in the first experiment.

This fact is fully recognised by Bemmelen. He states that the amount of indigo required, when added after the nitrate is mixed with oil of vitriol, is only about one-half the maximum quantity of indigo oxidisable by the nitrate. No definite proportion can, however, be fixed, as the volume of indigo used under the first named conditions is greater the quicker the operation is conducted.

The small amount of indigo consumed when the indigo is run from a burette into the mixed nitrate and sulphuric acid is not owing, save in small part, to the cooling of the mixture; nor by keeping the mixture for some time at a high temperature can any considerable further quantity of indigo be oxidised. These facts were ascertained by placing the flask in which the experiment was made in a bath of melted paraffin, kept at a temperature of 125° to 130° C. The simplest explanation of the facts is to suppose that nitric acid is lost on mixing a nitrate solution with oil of vitriol, and that therefore the full oxidising power of the acid is only ascertained when an excess of indigo has been present from the beginning. It seems questionable, however, whether the loss of nitric acid can in weak solutions be so considerable as to account fully for the phenomena observed.

In the results hereafter mentioned the quantity of indigo consumed will always be the *maximum*, ascertained in each case by a series of approximating experiments, in which the whole of the indigo was added before the oil of vitriol.

II. *The amount of Indigo required depends greatly on the proportion of Sulphuric Acid present, and within certain wide limits the amount of Indigo is less as the proportion of Sulphuric Acid is greater.*

This rule will be made at once evident by giving the results of a single series of experiments, in which the maximum amount of indigo oxidised by a fixed quantity of nitrate was ascertained for various proportions of sulphuric acid:—

Nitre Solution taken.	Indigo Solution required.	Oil of Vitriol for 1 Vol. of Mixed Nitre and Indigo.
10 c.c.	11·30 c.c.	1
10 ,,	10·40 ,,	1¼
10 ,,	9·75 ,,	1½
10 ,,	8·90 ,,	2

It appears from these figures that the largest amount of indigo was oxidised when an equal bulk of oil of vitriol was added to the mixed nitre and indigo solutions, and that when the proportion of oil of vitriol was raised to twice this quantity only about 79 per cent of the indigo previously required was oxidised. The larger, in fact, was the proportion of oil of vitriol, the smaller was the quantity of indigo consumed.

This fundamental law is not mentioned in any of the published investigations I have seen; the practical conclusion therefrom, that the same proportion of sulphuric acid must be present in all comparative experiments, is, however, partially stated by Sutton.

The facts described under this and the preceding section plainly show that the method of running indigo from a burette into a nitrate solution mixed with a fixed quantity of sulphuric acid can never yield reliable results. In this mode of working, originally proposed by Marx, and still employed by some chemists, the amount of indigo used is never the maximum quantity which the nitric acid could oxidise, and depends much on the quickness of the operator. The result must also be too low or too high, according as the quantity of nitric acid present is below or above that taken when the indigo was standardised. For it is clear that if less nitric acid is present, less indigo will be employed than was used in standardising; the proportion of sulphuric acid in the experimental mixture will therefore be greater; and we have just seen that if the proportion of sulphuric acid is increased, less indigo is consumed by each unit of nitrate.

It further follows, from the above law, that to obtain accordant results it is necessary that the oil of vitriol should always be added to the mixed nitrate and indigo solutions in a perfectly uniform manner. If any considerable part of the reaction takes place in the presence of less acid than the final proportion, as will be the case when the acid is gradually mixed, more indigo may be oxidised than properly belongs to the proportions used. On the other hand it is easy, by postponing mixing for a few seconds after adding the acid, to obtain low results, a considerable part of the reaction then taking place on the surface of the oil of vitriol, and consequently in the presence of a great excess of acid. The aim should be to effect the mixture in every case as completely and speedily as possible. The best mode of mixing is that recommended to me by Mr. W. Thorp. The nitrate and indigo are placed in a wide-mouthed flask of about 150 c.c. capacity. The measured quantity of oil of vitriol is placed in a test-tube or cylinder. The contents of the cylinder is then rapidly transferred to the flask, and the whole at once shaken. Irregularities of manipulation have their greatest influence when the nitrate solution is strong, and the reaction therefore immediate; errors (of deficiency) occur most readily when a small proportion of acid is used.

I am quite unable to explain why the presence of an excess of sulphuric acid diminishes the oxidising power of the nitric acid present. Sulphuric acid appears, however, to act in the same way with free chlorine, much more chlorine water being required to decolourise indigo in the presence of sulphuric acid than in its absence.

III. *The full amount of Indigo is consumed only when the temperature of the mixture remains sufficiently high during the reaction.*

This fact is abundantly recognised by all writers on the subject. Marx and Trommsdorff mention 100° as the minimum temperature of the reaction; Fischer, 110°; and Sutton, 120°. The heat necessary for the reaction is produced by the addition of the oil of vitriol to the solution. According to Sutton, the addition of 1¼ volume of oil of vitriol will produce a temperature of 135° to 140°: this is true if the oil of vitriol be of full strength, and the reagents at summer temperature. A small diminution in the strength of the acid makes, however, a decided difference in the temperature attained. The greatest heat is produced when 1¼ volume of oil of vitriol is employed; with 2 volumes the heat is slightly less, and with only 1 volume is somewhat further diminished.

Experiments were made on the effect of maintaining a full temperature by placing the flasks, immediately the oil of vitriol had been added, in a paraffin-bath of 120°: it was found that no more indigo was required as a result of such treatment, except in cases where the change of tint was not completed for more than half a minute. Such instances will only occur when working with very dilute solutions of nitrates, or in a room of low temperature, or with sulphuric acid deficient in strength. When this tardy reaction is manifested the temperature of the flask must be artificially sustained, or the results will be too low. A bath of chloride of calcium may be employed instead of paraffin.

IV. *The Tint of Final Reaction.*

The tints obtained differ somewhat according to the proportion of sulphuric acid used, the mode in which it is added, and other circumstances: the presence of chlorides also affects the colour.

When the indigo solution is freshly prepared, 1 volume of oil of vitriol employed, the nitre solution of Sutton's normal strength, and the acid suddenly added, the tint belonging to an excess of nitric acid is a deep reddish colour; with more indigo this darkens to a dull brown, and with still more indigo becomes greenish. Bemmelen has rightly stated

that the excess of indigo commences with the brown stage. If the brown solution is poured into several times its volume of water, the colour immediately changes to green. This treatment with water is a very convenient method of ascertaining the final reaction.

When 2 volumes of oil of vitriol are employed, the tint due to excess of nitrate is less deep and red than with 1 volume of acid, and approaches a dark sherry colour; with more indigo this passes through the brown and green stage. The brown, green, and superior tints, when poured into water, yield green for an instant only, the colour quickly passing into cinnamon. The cinnamon solution thus obtained is capable of decolourising a rather considerable quantity of indigo. It will be recollected that with 2 volumes of oil of vitriol far less indigo is oxidised than when a smaller proportion of sulphuric acid is used: it would appear that with 2 volumes of acid some lower oxide of nitrogen remains in solution, and on the addition of water becomes capable of destroying indigo.

With an intermediate proportion of oil of vitriol (1½ volumes) the tints are similar to those with 2 volumes, but more feeble in intensity; the brown tint and the tints superior to it change to green on dilution.

With very weak solutions of nitre the tints obtained with 1 volume of oil of vitriol are similar to those yielded by stronger solutions; the brown is changed into a distinct green on filling up the flask with water. With 1½ volume of acid the final tints are feeble and unsatisfactory. With 2 volumes of acid the tints produced are much deeper than with 1½ volume; the indigo and blue are specially intensified.

The best plan seems to be to adopt the brown tint whenever possible as the point of final reaction, or, more exactly, that particular brown tint which yields a distinct yellowish green on dilution. In all exact work a check experiment should be made with rather less indigo than that yielding this green tint, to make sure that no smaller amount of indigo will produce a similar reaction. Working with 2 volumes of oil of vitriol, the green tint produced by dilution must generally be dispensed with; but if the eye has been educated to the particular shade of brown which yielded green in the former cases, it will be able to discriminate this tint with fair accuracy without dilution. In the case of weak solutions the eye can be helped by transferring the contents of the flask to a cylinder.

In the case of experiments with 1 volume of oil of vitriol, the tint, whether in strong or weak solutions, soon reaches a definite point, beyond which no further change occurs. But with 1½ or 2 volumes of acid the tint continues to change slowly (especially in dilute solutions) after the first main reaction is over; if, therefore, definite results are wanted, it is quite necessary to time the experiment, and to take that as the final tint which is observed at a fixed interval after pouring in the oil of vitriol. I have taken two minutes as the period to elapse before the tint is recorded, but, except in the case of weak solutions, one minute would suffice.

The determination of the final reaction is undoubtedly one of the weak points of the method, but with care and practice the difference between similar experiments need scarcely exceed 1 per cent in the case of moderately strong solutions (1·0 to 0·5 grm. of nitre per litre), and with weak solutions (0·25 to 0·10 grm. per litre) should not be greater than 2 or 3 per cent, supposing that in each case an indigo of appropriate strength is employed.

A few experiments have been made with an indigo solution prepared by dissolving sublimed indigotine in sulphuric acid. With this solution the colour produced by an excess of nitrate is much less deep than with a solution of "indigo-carmine;" the tint is golden and not red, and passes into bright green without an intermediate brown stage. The colour reaction with this indigo solution is very sharp.

To be continued.)

ON THE

DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By E. F. TESCHEMACHER, F.C.S., &c.

In placing in the hands of Chemists one more process for determining the amount of Morphia present in Opium, it must not be assumed that the labours of my predecessors in this field have been ignored or disregarded by me. Most gladly would I have adopted any one of these numerous processes had it, on trial, afforded similar, definite and reliable results in the amount and purity of the morphia obtained. That these processes fail to yield satisfactory results when they are based on sound methods of procedure, is, to my mind, due, partly to the authors having failed to describe and insist on the necessity of following each and every step, however minute, of their process; and, partly, to their having, too readily, jumped to the conclusion of the excellence and certainty of their methods, without painstaking and long-continued investigation of the subject, and repeated reviewal and testing of every discernible or probable source of error.

On the first of these grounds, I claim the indulgence of all who may take an interest in the subject, for the many minute directions and explanations I shall feel it to be requisite to place before them; and as to the second I would assure them that the process described is but the outcome and result of very numerous experiments, the details and conditions of which have been changed and modified, as frequent practice for some years past proved to be advisable or necessary; so that the method as now worked out and described, but slightly resembles the process in its inception.

Amongst the conditions requisite to success in determining the amount of Morphia present in Opium, are:—

I. The avoidance of the use of Alcohol to extract the Morphia from the Opium. This rule leads at once to the rejection of very many facile and seemingly excellent methods; and the reason for its adoption is, that Alcohol dissolves the whole of the Narcotin as well as the Morphia present in Opium, and that, in practice, it is very difficult if not impossible to separate the whole of the Narcotin under such conditions from the morphia; so it is essential that the greater part of the Narcotin should remain undissolved in the refuse of the opium and never pass into solution.

II. The separation of the Meconic acid. This should be effected at an early stage of the process, so as to prevent the formation of a basic meconate on precipitation of the Morphia, which is very apt to occur unless all the Meconic acid is separated in the first instance.

The other conditions are rather details of the process than definite maxims, and are better included in the description of the method than apart from it.

Two special reagents are required in this process. The one prepared by mixing 1 part of solution of ammonia sp. gr. 0·880 with 20 parts of methylated alcohol, or of unmixed alcohol, and digesting in this mixture a large excess of Morphia for several days, with frequent agitation, so as to saturate it with Morphia. This may then be filtered for use when it will contain 0·33 per cent of Morphia, and for convenience sake may be termed "*Morphiated Spirit.*" The other is, Water saturated by frequent and long continued agitation with excess of Morphia and then filtered, which may in its turn be called "*Morphiated Water,*" containing 0·04 per cent of this alkaloid. It must be assumed that the sample of Opium to be examined has been properly drawn, and prepared by kneading and rolling together in a cool place; but this is best left to a skilled sampler, who is known to be competent to and careful in his work.

PROCESS.

1000 grains of Opium are macerated for twelve to twenty hours in about 4000 grains of cold distilled water, together

with 300 grains of Acetate of Lead, stirring the mixture from time to time. This separates the Meconic acid as Meconate of Lead, whilst the Morphia is dissolved in the Acetic acid set free.

After this maceration the Opium may be readily ground in a mortar to a paste and so much more cold distilled water added, rinsing the pestle and mortar with successive portions of it, as to fill with the mixture a measure =20,250 grains of distilled water: experience has shown that the space occupied by the insoluble matters measures from 200 to 300 grains, so that the limit of possible error by averaging and allowing 250 grains for the insoluble portion amounts to 0·05 per cent in Opium containing 10 per cent of Morphia. The mixture is to be filtered and 15,000 measured grains, =750 grains of opium, of the clear solution are to be evaporated to an extract on a water-bath, and this residue to be drenched with 3000 grains of boiling alcohol or methylated spirit, and the whole digested together with frequent stirring for about ten minutes. This separates the gum, &c., of the opium, which is insoluble in alcohol, and so far frees the solution of Morphia from impurity. At this stage of the process it is well to get rid of the excess of lead-salts, and for this end sulphuric acid is preferable to sulphuretted hydrogen; so much diluted sulphuric acid as may be equal to 30 grains of Oil of Vitriol will almost always be sufficient for this purpose, any excess of acid being converted into sulphate of ammonia by the subsequent addition of so much solution of ammonia as shall be equivalent to the 30 grains of oil of vitriol, thus forming a salt but slightly soluble in the alcoholic solution. This mixture may now be transferred to a beaker and allowed to settle for twelve hours, after which it is to be filtered and the filter and insoluble residue thoroughly washed with alcohol or methylated spirit. This alcoholic filtrate is then distilled, or evaporated on a water-bath to about 1000 grains; when, and whilst still hot, 400 grains of solution of ammonia sp. gr. 0·880 must be added, stirring rapidly and continuously for at least twenty minutes, whilst the beaker or evaporating dish and its contents should be cooled as rapidly as possible by plunging into an external vessel filled with cold water. This rapid and continuous stirring is most important, as the precipitation of the whole of the Morphia *in fine powder* is thereby effected, instead of the granular or mammillated condition so frequently met with, and it thus permits of the easy and thorough separation of all the Narcotin which may be mixed with the Morphia. When the cooling of the mixture and precipitation of the Morphia is thus attained, transfer it quickly and completely to a filter of sufficient capacity to hold the whole, and when the liquid portion has passed through, wash the remainder of the precipitated Morphia, adhering to the dish or beaker, on to the filter, using, for this purpose, the Morphiated spirit already described, and continuing the washing of the precipitate until it is completely freed from the mother-liquor. To do this effectually requires some little care: thus the Morphia on the filter must be kept in a spongy condition and never allowed to cohere, which is easily effected by pouring the Morphiated spirit round the edges of the filter so as not to disturb the precipitate, which must not be permitted to drain or solidify until this washing is completed.

The precipitate is now to be washed from off the filter-paper, with the Morphiated water previously described, and digested therein for a few minutes, which removes some more colouring matter together with any salts soluble in water but insoluble in alcohol which may have adhered to the precipitated Morphia; then once more collect the precipitate on a filter, washing it with Morphiated spirit, after this, once with ether, and finally thrice or more with Benzine, this completely frees it from Narcotin which is very soluble in benzine, morphia on the contrary being insoluble in this liquid. It now remains to drain and dry at a low temperature, say 100° F., the resulting pure and white Morphia, the weight of which will indicate the amount of this Alkaloid present in 750 grains of the opium under examination.

The beakers dishes and funnels employed should be covered, so far as may be practicable, to prevent much evaporation of the liquid made use of, although neither the Morphiated Spirit nor Water deposits any of the alkaloid with which they are charged until the greater portion of the respective liquids have evaporated.

In closing the description of this process, I may be allowed to remark that whilst it is by no means a rapid one, yet it is one that makes but slight demands on the time and attention of the operator, and I must finally be permitted to express my best thanks to Mr. H. Russell Smith for his careful and suggestive assistance in working out and simplifying the method I have now described for determining the amount of Morphia present in Opium.

1, Highbury Park North, London,
January, 1877.

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 28.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

In few branches of chemical technology is it possible to show an amount of progress equal to what has taken place in the manufacture of sulphuric acid during the last ten years. On the one hand, the production has been greatly augmented in consequence of the increased manufacture of soda, potash, by the preparation of artificial alizarin, nitro-glycerin, &c. On the other hand, the process of the manufacture of sulphuric acid has undergone essential alterations.

Whilst former investigations were chiefly undertaken in the hope of discovering new methods of procedure and new apparatus for the manufacture of sulphuric acid, attention has latterly been merely directed towards the discovery of new sources of sulphurous acid, of improved kilns, and of a theoretical elucidation of the process in the lead chambers—in use now for a century—with a view to its practical improvement.

Besides the memoirs of various chemists and technologists in the scientific journals the following works on the manufacture of sulphuric acid have appeared:—

1. M. J. Kolb, "Etude sur la Fabrication de l'acide Sulfurique Considerée au point de vue Theorique et Technologique." Lille, 1865. (Study on the manufacture of sulphuric acid considered from a theoretical and technological point of view.)

2. Dr. C. A. Winkler, "Untersuchungen über die Chemischen Vorgänge in den Gay-Lussac' schen Condensations apparaten der Schwefelsäure Fabriken." Freiberg, 1867. (Researches on the chemical processes in the Gay-Lussac columns in sulphuric acid works.)

3. "Handbuch der Chemischen Technologie Herausgegeben von P. A. Bolley, band ii., 1 gruppe, von Dr. P. Schwarzenberg." Braunschweig, 1869. (Handbook of technological chemistry, edited by P. A. Bolley, vol. ii., group 1, by Dr. P. Schwarzenberg.)

4. F. Bode, "Beiträge zur Theorie und Praxis der Schwefelsäure Fabrikation." Berlin, 1872. (Contributions to the theory and practice of the manufacture of sulphuric acid.)

5. Henry Arthur Smith, "The Chemistry of the Sulphuric Acid Manufacture." London, 1873. (A German version by Fr. Bode appeared at Freiburg, 1874.)

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

6. Lorenzo Parodi, "Sull' Estrazione Dello Solfo in Sicilia, e Sugli Usi Industriali del Medesimo." Firenze, 1873. (On the extraction of sulphur in Sicily, and on its industrial uses.)

The number of the compounds of sulphur applicable in the manufacture of sulphuric acid has considerably increased in the last ten years. Sulphur is only used in a few establishments; the chief material being iron pyrites, and in certain cases galena, sulphuret of copper, copper pyrites, blende, and Laming's mass.

Concerning new arrangements of the sulphur kilns nothing has been published. We must remark, however, that in certain works the pyrites furnaces have been converted into sulphur burners by the simple substitution of plates of cast-iron for the grate bars in consequence of the high price of pyrites in the years 1871—1873. Heidenreich, of Hanover, first converted his furnaces in the manner above mentioned, and burnt in twenty-four hours 120 kilos. of sulphur per square metre.

In Stettin, Hamburg, and other places sulphuric acid has been latterly made from sulphur in place of pyrites. But with the fall in the price of the latter the use of sulphur has again been abandoned.

The export of sulphur from Sicily has latterly reached the figures given in the subjoined table:—

1862	143,323	tons
1863	147,035	,,
1864	139,841	,,
1865	138,232	,,
1866	179,110	,,
1867	192,320	,,
1868	172,387	,,
1869	170,141	,,
1870	172,751	,,
1871	171,236	,,

For many years sulphur has been largely used in the vineyards of France, Italy, and Spain as a remedy for the grape disease. The increased production of gunpowder and ultramarine require likewise great quantities of sulphur, so that the decreased consumption of sulpur due to the use of pyrites in the manufacture of sulphuric acid has scarcely depressed the exportation from Sicily.

Roasting Pyrites.—The application of iron pyrites for the manufacture of sulphuric acid is now almost universal, and the extraction of this mineral has greatly increased in the last ten years. The largest quantity is consumed in England, and comes from Spain, Portugal, and Norway. The imports of iron pyrites and sulphur into Great Britain amounted in tons to:—(See below.)

France derives its supply of pyrites chiefly from Chessy and Saint Bel, near Lyons; in the north Belgian ores are used in small quantities. The pyrites consumed in Germany are chiefly produced from the "Sicilia" and "Siegena" mines, near Siegen; certain Rhenish mines produce also small quantities, such as the deposit of fine pyrites at Schwelm, Rammelsberg in the Harz district, &c.

The production of pyrites (in tons) in the following mines, amounted to:—

	Belgium.	Chessy and Saint Bel, near Lyons.	Goslar.	Siegen.	Total Prussian mines except Siegen & Goslar
1862	—	45,973	—	14,850	7461
1863	36,244	59,699	—	28,765	5934
1864	29,956	61,103	—	29,115	3437
1865	31,818	63,538	—	34,060	4187
1866	55,004	65,222	—	50,875	4302
1867	41,298	75,653	1599	71,835	4756
1868	37,933	75,656	2635	90,100	3953
1869	31,670	91,020	2689	64,789	6394
1870	28,665	63,464	3225	92,048	3191
1871	42,272	68,797	3324	110,432	4574
1872	40,932	99,000	3640	144,745	964
1873	—	127,000	1217	123,172	3748

The furnaces used in roasting iron pyrites vary according as they are intended for lumps, coarse, or smalls. The burners for lumps agree generally in the point that the ore is roasted on iron grate bars. The kilns employed in England have been repeatedly described—recently by H. A. Smith—and illustrated by diagrams. The individual furnaces are separated from each other by small vaults, and are connected in such a manner that the gases escaping into tho lead chambers may have an approximately constant amount of sulphurous acid. Each compartment is closed below by a separate door, at which the spent ores are removed. These doors are closed when a fresh charge of pyrites is introduced into the kiln from above, whereby the escape of any considerable quantity of sulphurous acid during the opening of the upper door is prevented. If the difference of level between the kiln and the flue leading the gases into the chamber is considerable air is drawn in and no sulphurous acid can escape on opening the working door.

The Belgian pyrites kilns have generally fixed grates. Beneath them is a large channel connected with the chimney. Before introducing a fresh charge of ore the workmen go into the channel and remove the exhausted ore which lies upon the grates with long iron hooks. Not to be inconvenienced by dust during this operation they open the damper which connects the channel with the chimney so that fresh air rushes to them in plenty. This arrangement affords at the same time a further advantage. If the access of air to the furnace could be hermetically closed it would be possible to hinder the escape of sulphurous acid when the doors are opened for the introduction of a fresh charge. But as hermetic closing is not practicable in kilns the loss may be avoided with the aid of the long channel. The outer door leading into the channel is closed as tightly as possible, and the damper leading to the chimney is opened just so wide that the air which enters the channel through the imperfect joints of the door passes beneath the grate bars into the chimney, and not up between the bars into the kilns. Too strong a draft would draw air down through the upper or working doors into the kilns, and consequently sulphurous acid would escape from the chimney. The combustion is therefore at a standstill till the new charge is spread out in the kilns; then the damper is closed, and

	Pyrites from—								Sulphur from—
Date.	Norway.	Germany.	Belgium.	Portugal.	Spain.	Italy.	Sundry Places.	Sum Total.	Sicily.
1862	4,975	6,817	9,860	53,296	33,717	—	2187	110,852	54,200
1863	6,736	15,409	12,059	109,180	33,213	—	2628	179,225	43,060
1864	16,087	12,751	7,069	118,489	15,529	—	1065	170,990	40,420
1865	22,229	14,727	2,121	137,787	16,393	—	369	193,626	49,840
1866	38,262	21,574	4,006	165,993	11,910	—	1625	244,596	62,850
1867	77,895	34,592	2,299	105,556	50,222	—	2134	272,698	59,270
1868	63,007	41,559	—	75,883	47,458	794	1019	229,720	64,080
1869	63,091	13,983	—	140,805	99,648	—	2420	319,947	51,580
1870	67,464	14,914	—	174,459	150,996	—	3676	411,512	54,120
1871	74,416	12,809	—	120,573	242,163	—	4581	454,542	—
1872	71,665	5,682	—	180,329	257,429	—	2521	517,626	—

the door leading into the channel is opened as far as the proper working of the kilns requires.

In France movable furnace bars have been used in the pyrites kilns for some time. They were, indeed, already known in 1848. They are convenient for the workmen, and afford besides the advantage in roasting that on moving the bars backwards and forwards only the lowest stratum of the charge falls out. The compartments are mostly separated from each other by arches; the kilns resemble the English pattern, but the stratum of ore is shallower, as for the most part richer, more combustible pyrites are employed.

In Germany kilns for lump pyrites are in use both of the French, the Belgian, and the English kind. A combination of the French and the Belgian kiln was introduced in 1866 in the "Rhenania" chemical works, near Stolberg, and this construction has since been more extensively adopted. The burnt ores are removed by means of revolving bars, because, on the Belgian method workmen often penetrate with their long hooks into layers still rich in sulphur, and thus the burnt ores show too high a percentage. In the "Rhenania" the long Belgian channel beneath the grates has been retained, permitting the introduction of a fresh charge without loss of sulphurous acid. It further permits the introduction of a waggon beneath the kilns, into which the spent ore falls at once and can be removed without the trouble of loading.

(To be continued.)

ON SOME

BLOWPIPE REACTIONS OF PHOSPHORIC ACID.

By MAJOR ROSS, late R.A.

(1.) Professor E. T. Chapman's article on "Blowpipe Reactions" (Chemical News, vol. xxxv., pp. 13, 26, and 36), affords a remarkable illustration of the danger incurred by drawing philosophical conclusions from results effected by *salts* used as reagents before the blowpipe, the confusion attending which was the very reason why I relinquished the use of *borax* and *microcosmic*, or (as the Freibergians call it) "*phosphor*" salt in 1869.

(2.) If I were seriously to propose to the distinguished Editor of this journal, or to any rational chemist, that he should commence an analysis in the "wet way," by attacking its subject with a solution of table salt instead of HCl; with Glauber's salt instead of H_2SO_4; or with cubic nitre instead of nitric acid, he would probably think me mad. Yet this is *precisely* analogous to the operation of commencing a pyrological examination by the solution of a substance in borax or P. salt before the blowpipe; a proceeding even less philosophical than the other, because here we have a fresh element of uncertainty introduced, viz., our ignorance of the comparative *volatility* of the constituents of these reagents, when their bases and acids are probably disconnected by the addition before the blowpipe, of other acids, or bases, or salts.

(3.) Prof. Chapman (who, if I mistake not, is an old Freiberg student, cited more than once in Plattner's "Probirkunst") says, with reference to Plattner's assertion that the P. salt "reaction" for silica—*i.e.*, the non-solution of silica in P. salt—is concealed by opalescence in the bead, caused by a "certain saturation" of the *base* of the silicate, when it consists of lime, magnesia, glucina, or yttria, "the inference implied in the above statement is quite erroneous. The opalescence of the glass arises entirely from precipitated silica." Prof. Chapman further states—"A simple experiment will show that this is the true cause of the opalescence. If some pure silica (or a silicate), in a powdered condition, be dissolved before the blowpipe in *borax* until the glass be nearly saturated, and some P. salt added, and the blowing continued for an instant, *a precipitation of silica will immediately take place*, the bead becoming opaque white on cooling. This test may be resorted to for the detection of silica in silicates which dissolve with difficulty in P. salt alone, or which do not give a well pronounced 'skeleton' with that reagent." I have italicised the words in the above quotation, which seem to me to represent an unauthorised induction from the experimental premises.

(4.) Obviously, the philosophical and most satisfactory way of solving the doubt which had arisen in Prof. Chapman's mind would have been for that eminent pyrologist to have either attempted—

A. The solution of silica in *pure phosphoric acid* before the blowpipe; or

B. The solution of phosphoric acid in *pure silica* before the oxy-hydrogen blowpipe.

He will find the results of A. in my work, "Pyrology, or Fire Chemistry," among which there is no such thing as opalescence. If he had tried operation B. in certain proportions, he would have probably produced a very fair imitation of the "Noble Opal."

(5.) Prof. Chapman, however, might have inferred the real cause of opalescence from the process followed in the ordinary manufacture of "*opaline glass*" (in which a phosphate, as bone-ash, *must* be employed), first discovered by Neri in 1610, whose recipe is "60 parts of fine white sand, 40 of potash, 10 of finely pounded bone-ash." Fontaineu afterwards improved the opaline appearance by mixing 576 parts of his glass (in which rock-crystal and lead are the chief ingredients) with 10 of silver chloride, 2 of *magnetite*, and 26 of bone-ash.

(6.) In India, in 1869, I attempted to make imitation opals, but not having the means of fusing pure silicic acid, I used instead, a substance known by chemists to bear great analogies to it, viz., *boric acid*. A trace of phosphoric added to a bead of boric acid before the blowpipe constitutes, on cooling, an almost perfect imitation of an opal, which, however, soon absorbs moisture from the atmosphere, and becomes opaque. There can be no analogous "precipitation" of boric acid here. Moreover, boric, dissolved in a bead of phosphoric acid to saturation, causes *no* opalescence. In fact, the former phenomenon constitutes the basis of my process for detecting phosphoric acid (*vide*, "Pyrology," pp. 185 to 191).

(7.) The *rationale* of the phenomenon of opalescence as regards P. salt added before the blowpipe to a saturated solution of silica in borax, seems to be that boric acid, being the most volatile constituent, is gradually expelled, silicic acid taking its place until sodium silicate (or glass) is formed. In the *Proc. Roy. Soc.*, vol. xx., is described an extremely hard bead I thus formed by dissolving silica in borax little by little for a whole fortnight. The fusion of phosphoric acid into this siliceous borax then occasions opalescence. The *constitution* of this opalescence is a subject for further enquiry.

(8.) To sum up. We see from operation B., paragraph (4.) that this opalescence cannot be, as Prof. Chapman confidently affirms it to be, due to "precipitated silica," for silica could scarcely be precipitated in a *medium* of fluid *silica*, and we should not fail to note the difference between "opacity," or "milkiness" as it is variously called, and *opalescence*. All cloudiness in an otherwise clear medium would appear to be due to opaque matter suspended in it, in a state of extremely minute division, but the most powerful microscope fails to resolve true opalescence into particles. It may be recognised by its property of appearing *yellow* by transmitted, *blue* by reflected light. Has Prof. Chapman discovered what occasions the opalescence of an *opal*?

(9.) A *second* edition of Von Engeström's translation of Cronstedt was published in 1772, the *first* being published in 1770. I presented a copy to the Cambridge University library in 1875. Magellan's edition (in two volumes) was the *third*, not the second as stated by Prof. Chapman. With regard to the discovery, if it can be so called, of the formation of a silica skeleton, when Bergman said that "silica is very slowly attacked by microcosmic salt," he stated in precise language the whole "reaction." It is, in short, a mere matter of solution, or

rather of non-solution, but I found that phosphoric acid dissolves about 5 per cent of desiccated silica, so that P. salt, containing soda, probably dissolves more. It is therefore an inefficient test for less than 5 per cent of silica, and Berzelius knew this very well. I found, in 1871, that a water solution of phosphoric, and even of boric acid, dissolves silica boiled in it to some extent, but Von Kobell published the former fact before I did in the tenth edition of his "Bestimmung der Mineralien," Munich, 1873.

of 800° to 1000° F. is required to work off a batch of salt-cake in a reasonable time; and where the arch of the furnace has been built as high as 4 ft. 9 ins. or 5 ft. above the bed, it is difficult to get the requisite degree of heat; consequently, the charge occupies double or treble the proper time for finishing, thus causing a loss of time, fuel, and labour. Insufficient draught through the condensers has in other cases operated to prevent the furnace being properly heated. Want of draught is of course fatal to

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 27).

TABLE III.—HÆMATITE IRON ORES.

Constituents.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Peroxide of Iron	73·30	79·66	69·20	82·57	63·00	84·57	90·28	79·00
Oxide of Manganese	0·54	0·54	2·36	0·44	0·72	trace	0·20	0·36
Lime	0·94	—	3·67	0·74	1·74	1·01	0·27	1·16
Magnesia	0·40	—	1·57	trace	1·33	0·10	0·24	trace
Carbonic Acid	1·02	—	4·48	—	2·82	0·90	0·47	0·92
Phosphoric Acid	0·16	0·18	trace	0·12	trace	trace	—	—
Sulphuric Acid	—	—	0·24	—	—	—	—	—
Sulphur	—	0·72	—	—	—	—	0·14	—
Iron combined with Sulphur	—	0·61	—	—	—	—	0·12	—
Alumina	2·08	2·75	3·70	0·67	4·09	2·28	1·20	3·52
Silica	14·41	12·60	5·82	14·24	23·20	8·75	3·36	13·36
Water	7·15	2·94	8·96	1·22	3·10	2·39	3·72	2·60
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	51·31	56·37	48·44	57·80	44·10	59·20	63·32	55·30

NOTE.—These Hæmatite ores are used in blast-furnaces in Scotland, and are brought from the North of England, excepting the last, which is Scotch.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, November 30th, 1876.

The PRESIDENT in the Chair.

MR. JONES read the following paper on "*Jones and Walsh's Patent Decomposing Furnace.*" At the special request of the Secretary I propose to read a brief paper on the recent experiences with this patent furnace, trusting that the discussion which may follow will be found of interest to the members.

Since this time last year a number of these furnaces have been erected and got to work on the Tyne, in Lancashire, Glasgow, Dublin, and other places; the experience of working most of these furnaces has been too short to speak positively of the results, and it should be no matter of surprise if the first attempts of the manufacturers have not in every case resulted in perfect success.

The want of complete success, where such has been the case, may be chiefly referred to two heads, viz.:—

1. Want of sufficient heat in the furnace to calcine or finish the sulphates.
2. The modifications, more or less great, that have been made in the construction of the furnace itself or of its details.

With regard to the first, the want of heat has been attributed, in a few instances, to the arch or roof of the furnace being constructed too high above the bed of the pan. It has been found in practice that a heat any furnace, and the remedy is to be sought in the direction of the condensers, connecting pipes, or flues.

A sufficient draught is indispensable to the proper output from the furnace, and no practical difficulty has been found in combining ample draught with the effectual condensation of the hydrochloric acid.

Second, the various modifications in the apparatus which have been tried. In one instance a double arch, as in an ordinary "Blind Roaster," has been tried with a view to keeping separate the gases from the fire and from those of the charge. This plan, however, had to be abandoned from the heat being found insufficient to calcine the charge.

Modifications of the *details* of the working parts have been numerous, chiefly as regards the *stirrers* or *scrapers*, of which a variety of forms have been tried; but so far as I have been able to learn, none of those in the plough shape, rigidly fixed to the cross arms, have been found to answer so well as the loose scrapers or *paddles*, partly owing to the caking of the salt-cake on the sole of the pan.

The best form of stirrer to avoid these evils, and at the same time to thoroughly expose the charge to the heat, is, I believe, still a desideratum. In our own works we have up to the present time found nothing to work better than the original scrapers or paddle blades attached to the cross arms by a wrought-iron shank, with a bolt and eye arrangement.

The greatest change in the apparatus, however, that has been forced upon ourselves and on some of our friends has been the abandonment of *cast-iron* and reversion to our original construction of *wrought-iron* in those portions of the machinery which are exposed to the full heat of the furnace.

It has been a great disappointment to find that not only the strong cross arms but even, in a few instances, the

vertical shaft of 7 to 8 inches diameter of solid cast-metal have, after exposure for some time to a heat of about 1000°, become extremely brittle, and broken down with a slight strain. I am bound, however, to correct this observation in reference to cast-iron from what I have actually seen in an establishment on the Tyne to-day, where cast metal working parts are a complete success, and stand a higher degree of heat than I have met with in other works; there is no doubt, however, that the explanation of this is to be found in the special combination of metal employed in this case.

In two new furnaces which we have recently constructed at our works, cast-iron is entirely dispensed with in the working parts except the scrapers, the cross arms being 5 inches square, wrought-iron, and the vertical shaft of 7 inches solid round iron. No accident has occurred with these in a furnace that has been at work at Middlesbrough for about two months, and in another furnace a pair of such wrought-iron arms, but only 4½ inches square, have been working continuously for 18 months, and are still perfectly sound and good.

It may be well to note that in the last new furnace it has been found an advantage to make the pan 12 inches deep instead of 9 inches, as before, and to have two drawing doors at opposite sides. In a pan of this depth, and 16 ft. diameter, there is no difficulty in working a charge of 6 tons of finished sulphates.

In order to get the arch lower and bring the heat more directly in contact with the charge, the roof of the furnace is carried upon flat metal girders for about one-third of the diameter, at each end, leaving a space of about 6 ft. in the centre, covered by a brick arch, so as to allow space for the diagonal stays to work which attach the cross arms to the vertical shaft.

In some furnaces the stays are dispensed with altogether, which enables the whole arch to be lowered. By this means the roof of the furnace for two-thirds of its length is brought within 3 ft. of the bed of the pan, and the work is expedited accordingly.

Another improvement in the arrangement of these pans is that open ways or passages, 18 inches wide, are left in the bed or brickwork going across from side to side *under the joints of the pan*. By this means any leakage which may occur can be seen and remedied at once, the access to the whole of the joints being quite easy without any stoppage of the furnace; such openings do not cause any damage by expansion and contraction.

It is remarkable how very small the wear and tear upon the pan itself appears to be. A pan recently taken out in our works, after 18 months' continuous use, is in perfect order, and shows absolutely no visible wear in any of the segments. The use of *hot* sulphuric acid of about 140° T. conduces to the safety of the pan, and is found to expedite the finishing of the charge.

The consumption of coke in treating sulphate of soda has averaged about 2¼ cwts. per ton of finished sulphate of soda, and about 3 cwts. per ton with sulphate of potash.

In conclusion it may be observed that the following points have been established by this year's working of the Jones and Walsh's patent furnace, viz.:—

1. That nuisance arising from the escape of vapours from the furnaces or from the batches of salt-cake has been almost entirely overcome.
2. That the condensation is effectually performed and the muriatic acid recovered at a strength varying from 24° to 30° T. (See list of chimney tests.)
3. That the finished sulphates are of a superior quality and of a more uniform character.
4. That allowing for the extra cost of coke (as against coal where used) *steam*, &c., a material saving in labour, in wear and tear, and also in sulphuric acid, is effected as compared with the manual labour system of decomposing.

The following is a list of the chimney tests for the last month :—

Analyses of Sulphate of Potash.

By R. R. Tatlock.

(From Jones and Walsh's Patent Furnace.)

Date.	Chloride.	Free Sulphuric Acid.
August 14, 1876	1·02	1·44
,, 26, ,, ...	0·69	1·84
Sept. 7, ,, ...	0·59	2·10
,, 14, ,, ...	0·81	1·30
,, 20, ,, ...	1·56	1·96
,, 25, ,, ...	0·89	1·64
,, 30, ,, ...	0·87	1·76
October 9, ,, ...	1·23	2·04
,, 30, ,, ...	0·31	1·84
Nov. 3, ,, ...	1·14	1·44

Copy from Test-Book of Chimney Tests for the Month of November, 1876.

Tested by A. R. Hudson.

Date.	HCl per Cubic Foot Escape.
November 1, 1876	0·10 grs.
,, 2, ,, ...	0·10 ,,
,, 3, ,, ...	0·11 ,,
,, 4, ,, ...	0·15 ,,
,, 6, ,, ...	0·12 ,,
,, 7, ,, ...	0·12 ,,
,, 8, ,, ...	0·10 ,,
,, 9, ,, ...	0·11 ,,
,, 10, ,, ...	0·10 ,,
,, 11, ,, ...	0·11 ,,
,, 13, ,, ...	0·11 ,,
,, 14, ,, ...	0·11 ,,
,, 15, ,, ...	0·10 ,,
,, 16, ,, ...	0·12 ,,
,, 17, ,, ...	0·11 ,,
,, 18, ,, ...	0·15 ,,
,, 20, ,, ...	0·10 ,,
,, 21, ,, ...	0·11 ,,
,, 22, ,, ...	0·10 ,,
,, 23, ,, ...	0·11 ,,

Result of Experiments at Felling Chemical Works.

Communicated by Messrs. H. L. Pattinson and Co.

Jones's Furnace—		
O.V. used, on wet salt	78·00	per cent
,, real salt	85·80	,,
Hand Furnace—		
O.V. used, on wet salt	82·00	,,
,, real salt	90·00	,,
Theoretical quantity—		
O.V. used, on wet salt	76·22	,,
,, real salt	83·76	,,

(Total foreign matter in the salt used, 9 per cent.)

The saving of O.V. in Jones's furnace over the hand furnace, as shown above, amounts on the real salt to 4·2 per cent.

In the course of the discussion Mr. Pattinson asked what the amount of hydrochloric acid was on an average in the chimney gases from the furnace, per cubic foot?

Mr. Jones replied that the tests were taken by their own chemist in the chimney. The grains per cubic foot of escape for the whole of November were something like this: 0·10, 0·11, 0·15, 0·10, 0·15. None of them exceeded 0·15.

Mr. Mease asked how many tons of fuel there was put into the chimney per week, and how many tons of sulphate were worked.

Mr. Jones said they burnt about 250 tons of fuel per week altogether in the works; and as to the sulphates they produced from 110 to 120 tons per week. Dr. Angus Smith altered Mr. Todd's arrangement for taking the gases in the chimney, brought his own tube, and thrust it 5 feet into the chimney. He had worked it out with

his own hands; and stayed at the works for three days once for the purpose of testing personally.

On the question of the evolution of the gases, Mr. MEASE said that one Saturday after the work had finished the water was stopped in the condenser, and he tested the strength of the acid for several hours; and for that time the strength of the acid kept up almost as strong as it was while the batch was working for some hours. It gradually got lower and lower. That pointed to this fact—that the amount of coke in the condenser holds a large amount of gas upwards; then the water coming down gradually washes down those gases, and in time the acid gets weak, showing that the strength of the acid at any particular moment is no criterion as to the amount of gas which is being evolved at that moment, on account of the large reserve of acid in the condenser.

Mr. HILL said that at the St. Bede Works they had turned out from 75 to 80 tons of the best sulphate of soda per week with great regularity, five and a half days in the week, and twenty-four hours a day, when decomposing common salt; and when working nitre cake and salt they could turn out nearly 100 tons a week.*

Mr. FRANCE thought he could add a little fact to the question of condensation. They had an ordinary decomposing furnace, such as is used on the Tyne—one doing, say 65 tons a week; and it went into a pair of 25 feet condensers, and then to the chimney. They never could succeed in getting the alkali down to one-fifth of a grain, the limit required by the Act; but when working Jones's furnace afterwards into the same pair of condensers, the gas at the outlet, before going into the chimney, never exceeded one-fifth of a grain. He might add, that having no use for the hydrochloric acid, they did not care how much water they put in. In each case an unlimited supply was put in.

Mr. H. L. PATTINSON, Jun., said that in an ordinary decomposing furnace, if you kept the same feed on, and kept putting quantities of acid into it, you would naturally have an excess at one time and too little at another; but with Jones's furnace, owing to its coming off in a more regular way, this was not so, and they would get a greater condensation on the average.

Mr. JONES said, there was the question as to whether a sufficient output could be got from the furnaces. He thought this point had been most satisfatorily solved by Mr. Hill. He had seen two furnaces at work that day at the St. Bede Works, where they seemed to have hit the happy medium of getting a full amount of output from the furnace, combined with protection to the ironwork.

ACADEMIE DES SCIENCES DE ST. PETERSBURG.

M. AVENARIUS, "*On the Conditions Determining the Critical-Point.*" The author describes a series of experiments on the critical-point of ether conducted in an apparatus of his own design. The results lead to the conclusion that the critical-point is not occasioned by an equivalence of the specific volumes of liquid and vapour, according to the hitherto-received theory, but is to be expressed by the equation—

$$\frac{T}{p}\frac{dp}{dT} = 1,$$

where T = the absolute temperature, and p = the vapour-tension corresponding to this temperature.

O. CHWOLSON, "*On a Mercury Rheostat designed by H. von Jacobi.*" This somewhat complicated rheostat was completed by von Jacobi shortly before his death, and is here first described for the first time. It is especially adapted for such galvanometric investigations where it is important either to measure directly small resistances, or to follow accurately the minute changes in given resistances. Its leading features are easily attainable accuracy in the arrangement, minuteness of the recognisable and measurable resistances, unchangeability of the variable resistance in the course of time, possibility of removing during an experiment any increase of temperature in the variable resistance caused by the current, and ability to change the mercury forming the constant resistance after each experiment, thus avoiding the consequences of a rise in its temperature.

R. LENZ, "*On the Application of the Theory of the Division of the Galvanic Current to Decomposable Conductors.*" Experiments were made with solutions of sulphates of copper and of zinc, and the nitrates of copper and of silver in various degrees of concentration, the results of which, without exception, led to the conclusion that Kirchhoff's law for the bifurcation of the galvanic current in metallic conductors is equally applicable to liquid conductors.

G: LAWRINOWITSCH, "*On the Pinacon and Pinacolin derived from Methyl-Ethyl-Keton.*" Treatment of this keton with hydrogen *in statu nascendi* yields a pinacon with the formula $C_8H_{18}O_2$, which forms a white crystalline mass, and melts at 28°. Further treatment with dilute sulphuric acid changes into the corresponding pinacolin, $C_2H_5(CH_3)_2.C.CO.C_2H_5$, a mobile liquid possessing all the properties peculiar to tertiary ketons. The correctness of the formula was shown by oxidation, which yielded acetic acid and dimethyl-ethyl acetic acid, $C_2H_5(CH_3)_2C.COOH$.

* The maximum output at the St. Bede Works from one Jones's furnace has been 103 tons in five and a half days working.

NOTICES OF BOOKS.

Instruction in Photography. By CAPTAIN ABNEY, R.E., F.R.S., &c., Instructor in Chemistry and Photography at the School of Military Engineering, Chatham. Third Edition. London: Piper and Carter, 1876.

THE fact of the first two editions of Captain Abney's excellent treatise having been absorbed in less than two years is a sufficient proof of the high estimation in which it is held, both by professional and amateur photographers. The chief merit of the work is its completeness as a working manual and the practical manner in which the various processes are described, the theoretical information contained in it being reduced within the smallest possible compass. A sketch of the way in which Captain Abney carries the learner through the collodion process will give an excellent idea of the manner in which the rest of the subject is treated. Beginning with the different descriptions of glass used in photography, and the best methods of cleaning them, the author proceeds to give the best formulæ of making pyroxyline and collodion, describing the properties of seven different kinds of iodisers and bromisers at great length, and explaining with great clearness the different purposes for which each particular kind of collodion is specially fitted, a species of knowledge which has hitherto received too little attention in works of this kind. The photographer no longer uses the the same collodion in hot and cold, bright and foggy weather, or for portraits, landscapes, and copying as in the old days, but varies the kind of collodion and iodiser or bromiser according to the conditions under which he is working, and the class of subject he is engaged upon. We are glad to see that Captain Abney very properly condemns the practice of using methylated ether and alcohol as solvents for collodion. He next passes on to the sensitising-bath, which he describes somewhat briefly, and then gives a list of nearly a dozen different kinds of developers, minutely describing their peculiarities and the special purposes for which they are fitted. Intensifying next claims his attention, nearly a dozen solutions for increasing the thickness of the silver deposit, or for changing its colour to a more or less non-actinic hue, being given.

We do not remember having seen any manual in which these two important subjects have been treated of so fully as in the book before us. A number of formulæ for fixing solutions and varnishes being given, the various manipulations in wet-plate photography next receive the author's attention, practical details being entered into with great minuteness. A large portion of this section of the work is devoted to defects in negatives, their causes and remedies, and the professional or amateur who cannot get himself out of a "mess" by the aid of Captain Abney's instructions must indeed be unfortunate. This part of the book ends with an account of the nearly exploded positive wet process.

The various dry and emulsion processes, of which fourteen or fifteen are given, are then described, tea, coffee, beer, and stout (!) being among the preservatives mentioned. Surely there must be something very empirical about this branch of photography when such substances are used. The paper negative processes we should have thought were as obsolete as the daguerreotype; they are, however, described at length. Instantaneous pictures, photographing interiors, copying plans, transparencies, the reproduction of negatives, and paper enlargements are also very fully described. So far, the production of negatives on glass and paper. The positive printing process is then fully treated of, followed by directions for cutting, mounting, and rolling the finished prints, thus completing the first part of the work.

The second part describes the various processes for the more or less mechanical reproduction of positive prints by the autotype and powder processes, Woodbury type, heliotype, photo-lithography, zincography, &c.

The photographic enamelling process is well described, and seeing the ease with which it is carried out, and the beautiful and practically indestructible results obtained, it seems strange that it has not been more universally adopted by the professional photographer. Hints on apparatus, and a number of practical receipts and tables bring this excellent manual to a conclusion.

An exquisite little Woodbury type of a woodland scene in Windsor Forest from a negative by Captain Abney is given as a frontispiece, but the specimen of the photo-relief process (page 164) from the reproduction of woodcuts is a pitiful failure.

In his preface Captain Abney informs us that he is about to publish another Manual, to form part of Messrs. Longmans' "Text-Books of Science," which will enter much more fully into the theory of the subject; we shall await its appearance with great interest, such a work being much wanted.

CORRESPONDENCE.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

SIR,—I should like to call your attention to the following advertisement, which has for some time past appeared constantly in the Berlin *Kladderdatsch*:—

Doctor-Diplome jeder Facultät werden leicht und billig vermittelt.—Adr. Medicus, Royal Square, Jersey, England.

(Doctors' diplomas of every faculty easily and cheaply obtained.)

This advertisement, I fear, is doing much to give English degrees a bad odour in Germany. I think some of your countrymen should investigate the case, and if it be a swindle expose it.—I am, &c.,

DR. P. TOWNSEND AUSTEN.

School of Mines, New York, U.S.A.

GRADUATION OF THERMOMETERS.

To the Editor of the Chemical News.

SIR,—Will any one of your readers kindly explain, through you, how thermometers, graduated as they now are, can indicate equal amounts of caloric. Should it be granted that both mercury and glass each expand with like quantities of caloric in their own equal proportions, it then follows that if the length of the tube of a thermometer, which is made of a material which is in no way changed by caloric, be from the freezing to the boiling-points of water, that is, from 32 to 212, which is 180°, divided into 1·00000000 parts, each degree will be in length 0·00555555, and that if the tube of such thermometers be made of glass, that then, as now graduated, the length of each degree will be 0·00555105, as in that case the amount of the expansion of the glass tube between the freezing- and the boiling-points of water, viz., 0·00081000, has first to be deducted, and then the difference has to be divided by 180°.

As the present usage is to graduate the entire thermometer with degrees, each of which is in length 0·00555105, any further expansion of the glass tube can in no way be indicated; and yet the length of the tube from the freezing- to the boiling-points is, with every additional 180° of caloric, equally expanded as it was with the first 180°, and ought to be indicated by the thermometer.

Should the range of a thermometer be 630°, the length of the glass tube of each of these degrees may be expanded 630 times; consequently the total number of expansions are 396,900, and as the total expansion of the glass tube between 32 and 212 is 0·00081000, it, when divided by 180 × 180, that is, by 32,400, gives 0·000000025 as the length of each expansion. Hence any degree multiplied by its own number from 32°, and the result of such multiplication by 0·000000025, always gives the entire length of the expansion of the tube from 32° to the degree sought; and this length, deducted from the sum of 0·00555555 multiplied by the number of the degree from 32°, gives the entire length of the tube from 32 to the degree sought. The difference between the length of the tube at any degree, say 211, and of it at that which precedes it, say 212, is the correct length of the graduation of the 212th degree; or the length of the graduation of any degree, say 212, may be obtained, thus, 180 × 2 − 1 × 2½ (or 0·000000025) − it from 0·00555555, remainder 0·005546575, which is the correct length of the graduation of degree 212.

The difference between the present graduation of a thermometer and what I consider to be the correct graduation of it is as follows:—

Correct Graduation.

Degree.	Length of Degree.	Length of Tube above 32°.
633	0·005525525	3·32985552
212	0·005546575	0·99918900
32	0·005555525	—

Present Graduation.

Degree.	Length of Degree.	Length of Tube above 32°.
632	0·005551050	3·33063000
	(More than 1 degree error.)	
212	0·005551050	0·99918900
32	0·005551050	—

Having for fifty years been convinced that thermometers, as now graduated, do not indicate the measure of the quantity of caloric, I now venture to seek an explanation of the ground on which they are considered to do so.—I am, &c.,

F. PARKER.

Highgate, January, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 3, January 15, 1877.

Nature and Contagion of the Malady known as Typhoid Fever.—M. Bouillard.—A lengthy paper, not adapted for abstraction.

Experiments on the Coagulation of Fibrin.—M. A. Schmidt.—The author points out two species of animal liquids—the protoplastic, so called to distinguish them from the liquids which coagulate spontaneously, and which contain a ferment, and the fibrinogenous liquids.

The Phenomena of the Radiometer explained by the Aid of Pyro-electricity.—W. de Fonvielle.—It is known that pyro-electric phenomena are not merely manifested on the surface of certain crystals when submitted to a change of temperature. Every non-conductor if submitted to the action of luminous rays is heated, and becomes more or less strongly electric according to the nature and the intensity of the action. I believe that these considerations suffice to explain all the phenomena of the radiometer hitherto observed. The pyro-electricity developed by the passage of luminous rays through the glass is manifested merely in the interior and on the illuminated hemisphere, for the electricity liberated on the exterior is dispersed in the air, and produces no effect. On the other hand, the blackened discs being heated more strongly than the polished disks are more strongly electrified, and are therefore repelled more energetically. The motion must take place in the direction actually observed. If the radiometer is plunged into water we perceive that the glass of the capsule cannot be heated, that the interior surface is not in a condition to become electrified, and that consequently no electric reactions can take place. If the case of the radiometer is suspended by a thread we shall have, of course, a rotation in the direction opposite to that of the torsion apparatus, for the elementary actions being all equal, and in opposite directions, the two movements must consume exactly the same dynamic power. This is the essential character of all the reactions to which electricity gives rise. If the "mill" is immersed in air, or in a gas at the normal pressure, pyro-electricity can no more be developed in the interior of the case than on the outside: the movement of the "mill" therefore occurs in consequence of the decreased pressure of the gas upon the blackened disks, *i.e.*, in the inverse direction of the normal rotation. This normal movement is only produced as soon as the internal pressure of the case is so far diminished that electrisation can be developed by heat. It must cease when the vacuum is so perfect that the electric spark can no longer circulate, for them the reactions between the "mill" and the case can no longer be produced. The presence of a certain quantity of gas is therefore necessary, not as a mechanical propeller, but as a vehicle of electricity. The cessation of motion in a too perfect vacuum which appears to be established by decisive experiments is therefore explained without the aid of any new hypothesis on the internal constitution of gaseous bodies. All other conditions being equal, the radiometer will revolve the more rapidly the smaller the receiver, because the disks will be at a less distance from the electrised surface upon which they react, as Mr. Crookes seems to have established. If we suspend a disk of mica in the interior of the receiver, and above the "mill," its rotation will be explained like that which is produced in the air if we submit the same disk to the influence of an electrifying machine. The same forces will determine the movement in both cases, since the "mill" is charged by means of the light with electricity of tension comparable to that which is developed by the rotation of the plate of the machine. All considerations of a mechanical impulse due to the gas are superfluous. We thus understand why disks of mica should be more sensitive, other things being equal, than disks of aluminium, for it is well known that crystalline substances disengage pyro-electricity much more easily than metallic bodies more or less completely coated with isolating substances. It would be interesting to examine the same phenomena during the period of heating or cooling, with plates cut perpendicular to the crystallographic axis of bodies which, like tourmaline, possess axial pyro-electricity.

New Derivative of the Albuminoids.—M. P. Schützenberger.—The new compound is of a dull chalky white, and always crystallises in balls more or less voluminous. At 16° water dissolves 5·3 per cent, but at a higher temperature it is more soluble. It is insoluble in ether; sparingly soluble in cold alcohol at 90 per cent; rather more freely soluble in hot alcohol. If heated in the absence of air it melts between 245° and 250°, and is decomposed. Its elementary analysis leads to the formula $C_7H_{11}NO_2$.

Optical Properties of Mannite.—MM. A. Müntz and E. Aubin.—A reply to certain strictures of M. G. Bouchardat (Session of the Academy, January 3, 1877).

Action of Chloro-chromic Acid upon Organic Bodies.—M. A. Etard.—The author has examined the action of chloro-chromic acid upon certain hydrocarbons, especially toluen. One of the products obtained was chloride of benzyl.

Chemical Examination of the Mistletoe (*Viscum album*).—MM. Grandeau and Bouton.—The twigs of the mistletoe differ essentially in their chemical composition from those of the trees upon which it grows, but nevertheless vary with the latter. They contain more phosphoric acid and potassa than the trees, but less lime.

Detection of Magenta and other Analogous Colours in Wines.—M. A. Béchamp.—Not suitable for abstraction

Justus Liebig's Annalen der Chemie,
Band 184, Heft 1 and 2.

Behaviour of Palladium in the Flame of Alcohol.—F. Woehler.—The author finds that palladium is not capable of taking up ethylen gas or gases from the flame of alcohol, but that it determines the separation of carbon at a temperature at which ethylen gas is not alone decomposed.

Constitution of Ultramarine.—Julius Philipp.—Not suitable for abstraction.

Certain Derivatives of Desoxybenzoin.—A. Zagoumenny.—The author has examined the action of alkalies dissolved in certain primary and secondary alcohols upon desoxybenzoin.

Formation of Diphenyl-carbinol, and on certain of its Derivatives.—A. Zagoumenny.—Benzophenon dissolved in an alcoholic solution of potassa is converted into diphenyl-carbinol on boiling with zinc.

Action of Nitric Acid upon Tri-brom-phloro-glucin.—Dr. R. Benedict.—Amongst the substances formed are bromopicrin and oxalic acid.

Reimann's Farber Zeitung.
Nos. 43 and 44, 1876.

These numbers contain nothing of general interest.

No. 45, 1876.

Dr. Walz has discovered vanadium in the magnetic iron ores of America, sometimes in not insignificant quantities. Blake has found vanadium in the mica of California and König in the magnetic iron ores of Arkansas.

No. 46, 1876.

This issue contains nothing of interest.

MEETINGS FOR THE WEEK.

SATURDAY, Feb. 3rd. Physical, 3. Annual General Meeting; Election of Officers, Council, and Honorary Members. "On Vortex Motion," by Prof. Osborne Reynolds. "On Apparatus to Illustrate Wave Motion," by C. J. Woodward, B.Sc.
MONDAY, 5th.—London Institution, 5.
—— Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
TUESDAY, 6th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Zoological, 8.30.
WEDNESDAY, 7th.—Society of Arts, 8. "Street Tramways," by Capt. Douglas Galton, C.B.
—— Geological, 8.
—— Microscopical, 8. (Anniversary).
—— Pharmaceutical, 8.
THURSDAY, 8th.—Royal, 8.30.
—— London Institution, 7.
—— Royal Institution, 3. Dr. Wright, "On Metals and the Chief Industrial Uses of these Bodies and their Compounds."
—— Society of Arts, 8. (Chemical Section). "Some Processes of Nature's Hygiene (Improvements in the Production of Antiseptics, Disinfectants, and Blood Albumen)," by C. T. Kingzett, F.C.S.
FRIDAY, 9th.—Royal Institution, 9. "Typical Laws of Heredity," by F. Galton.
—— Astronomical, 3. (Anniversary).
—— Quekett Club, 8.
SATURDAY, 10th.—Royal Institution, 3. "Florence and the Medici," by J. A. Symonds.

TO CORRESPONDENTS.

Dr. R. Carter Moffat.—Will this gentleman kindly forward his present address to our office.

P. Macintyre.—Mr. Bowditch and Mr. Sugg have both written books on the subject.

S.—It is given in most books on commercial analysis. See Crookes's "Select Methods in Chemical Analysis."

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THE CHEMICAL NEWS

VOL. XXXV. No. 898.

ON THE QUANTITATIVE DETERMINATION OF NITRIC ACID BY INDIGO.

By ROBERT WARINGTON.

(Concluded from p. 47).

V. *Influence of Dilution on the amount of Indigo required.*

For a volumetric method to admit of easy and satisfactory use it is necessary that the substance sought, whether in a dilute or strong solution, should always correspond to the same quantity of the reagent employed: the evidence before me leads me to doubt if this is altogether the case in the present method. The question is not an easy one to decide, for to do this demands absolute freedom of the oil of vitriol from oxidising or reducing substances. As the volume of oil of vitriol employed is little affected whether a dilute or strong solution of nitrate is operated on,—indeed remains unchanged if the indigo solution be diluted equally with the nitrate,—the proportion of the sulphuric acid to the nitre will vary inversely with the quantity of the latter present. It follows that if the oil of vitriol contain nitrous impurities, possessing an oxidising power, halving the strength of the nitrate solution will not halve the indigo required, but an increased proportion of indigo will be demanded per unit of nitre. On the other hand, if the oil of vitriol contain sulphurous acid, or other reducing matter, the effect will be in the contrary direction, and a smaller quantity of nitre will require a diminished proportion of indigo. Should the strength of the nitrate solution be increased instead of diminished, the errors will be in contrary directions. As the proportion of oil of vitriol employed is always very large in relation to the nitrate present, traces of impurity in the oil of vitriol are able to produce sensible effects. Before describing the results obtained it will be well to mention the precautions taken with regard to the oil of vitriol used in these experiments.

The acid was purchased as pure distilled oil of vitriol; it had, however, a scarcely perceptible smell of sulphurous acid, and was not absolutely free from colour. When the acid was violently shaken in a half-filled bottle, and the atmosphere of the bottle tested for sulphurous acid with iodine paper, after the method I have elsewhere described (CHEM. NEWS, xvii., 75), the presence of this acid was plainly manifested. This oil of vitriol was purified by heating for six hours, to near its boiling-point, in a capacious flask freely open to the air. It then became absolutely colourless, and the iodine-test failed to reveal the presence of sulphurous acid. This was the acid employed in the following experiments. As, however, the results obtained by its use might be partly explained by assuming the presence of a small quantity of reducing matter, a portion of the purified acid was subjected to further treatment. To 1 litre of the acid was added 1 grm. of nitrate of ammonium, and the whole heated to near boiling for several hours. The acid was then strongly nitrous, and in a blank experiment destroyed a considerable amount of indigo. It was presumed that all reducing matter must now be destroyed. Some crystals of pure oxalate of ammonium were next dissolved in the acid, and heating resumed. In about an hour all nitrous compounds had disappeared. The acid was then brought to its boiling-point, and boiling continued for two or three hours. The acid thus prepared gave exactly the same results as before treatment with nitrate of ammonium. In order to confirm this result, the removal of all reducing matter was further attempted by a second method. To 1 litre of the purified acid were added 5 grms. of peroxide of manganese, and the whole heated to near boiling till the manganese was dissolved. On cooling, the sulphate of manganese crystallised out. The acid was decanted off, and used for experiments with indigo: the results were similar to those before obtained. I conclude, therefore, that the oil of vitriol employed was free from reducing substances.

The following table shows the number of cubic centimetres of indigo solution required by 10 c.c. of three solutions of nitre, containing respectively 0·01011 grm., 0·005055 grm., and 0·0025275 grm. of nitre. Each nitre solution was tried with four proportions of oil of vitriol.

	Normal Nitre Solution.	Half Strength Nitre.	Quarter Strength Nitre.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo
	c.c.	c.c.	c.c.	
Indigo required in experiment ..	11·30	5·70	2·85	1
Dif. from calculation	—	+0·05	+0·025	
Indigo required ..	10·40	5·15	2·50	1½
Dif. from calculation	—	−0·05	−0·10	
Indigo required ..	9·75	4·75	2·30	1½
Dif. from calculation	—	−0·125	−0·138	
Indigo required ..	8·90	4·20	1·90	2
Dif. from calculation	—	−0·25	−0·325	

Two other series of experiments may be quoted; in these, after determining the relation of the indigo solution to the nitre, both solutions were diluted to four times their volume, and again tried against each other. It is evident that if dilution does not disturb the relation of indigo to nitrates the same volume of indigo should be required in the second trials as in the first. The following table shows the number of cubic centimetres of indigo required in each case.

	Normal Nitre and Indigo.	Quarter Strength Nitre and Indigo.	Difference.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.
	c.c.	c.c.	c.c.	
Indigo required ..	11·50	11·70	+0·20	1
„ „ ..	9·80	9·40	−0·40	1½
„ „ ..	8·85	7·50	−1·35	2

The acid purified with manganese was tried with normal and quarter strength solutions, as just described, a different indigo being used from that employed in the last-quoted experiments. The results were as follows:—

	Normal Nitre and Indigo.	Quarter Strength Nitre and Indigo.	Difference.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.
	c.c.	c.c.	c.c.	
Indigo required ..	11·10	11·30	+0·20	1
„ „ ..	8·15	7·40	−0·75	2

As, however, the acid contained a trace of oxidising matter (as shown by a blank experiment with indigo), the "difference" in the case of 1 volume of oil of vitriol will be less, and in the case of 2 volumes greater, than here stated,

Many other similar experiments have been made; they all point to the same conclusion as those here quoted. It appears that when 1 volume of oil of vitriol is employed dilution of the nitre does not greatly disturb its relation to the indigo, and that the tendency under such circumstances is for nitre diluted to take a little more indigo than nitre concentrated. When 1½ volume of oil of vitriol is employed the error becomes distinct in the opposite direction. When 2 volumes are used the error becomes very considerable, nitre diluted taking decidedly less indigo than nitre concentrated. In fact, taking the figures of the first table, if the indigo had been sta-

dardised with a normal nitre solution, and the solution to be analysed had contained only one-quarter this proportion of nitre, the result reported would have been 14·5 per cent below the truth,

The experiments certainly show that every operator must ascertain for himself, with his own reagents, whether differing volumes of indigo really correspond with similar differences in nitric acid.

VI. *The Influence of Chlorides.*

According to Marx, chlorides have no influence on the reaction: the same statement is made by Sutton, limited, however, to the chlorides present in waters. I have made a few experiments in which from 0·03 to 0·10 grm. of chloride of sodium was added to 10 c.c. of nitre solution: the result in every case was a small, but distinct, diminution of the quantity of indigo required. The mean of four fairly agreeing experiments with a nitre solution of normal strength showed that 100 parts of chloride of sodium had a reducing effect equivalent to 1·16 of nitrate of potassium.

When a sufficient amount of chloride is present the series of tints is entirely changed, the colour varying from gold to bright green: in the above experiments the first distinct shade of green was taken as the final reaction. When only a little chloride is present the first green colour is obtained by dilution, as already described.

The addition of a sufficient amount of common salt practically changes the conditions to those occurring in Boussingault's method. The final tint is green in both cases: experiment also showed that the same weight of nitre requires considerably less indigo when heated with hydrochloric acid than when mixed with sulphuric acid. 10 c.c. of nitre solution required 6·9 c.c. of indigo when treated by Boussingault's method, but 9·6 c.c. of the same indigo was needed when the experiment was repeated with 2 volumes of oil of vitriol. This is a direct confirmation of the statement just made, that chlorides tend to reduce the amount of indigo required.

VII. *The Influence of Organic Matter.*

It will be recollected that Boussingault found that certain kinds of organic matter had a very prejudicial effect, the nitric acid attacking these as well as the indigo, and thus seriously reducing the amount of indigo oxidised. It was important to ascertain whether the same effect would take place in the sulphuric acid method; experiments were therefore made with cane-sugar, using both weak and strong solutions of nitre, and various proportions of oil of vitriol. The results were as follows:—

Nitre, Normal Strength.	Cane-Sugar.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.	Indigo required.	Reducing Effect of 100 of Sugar expressed in Nitre.
10 c.c.	None	1	13·7 c.c.	—
10 ,,	0·01 grm.	1	12·7 ,,	7·4
10 ,,	None	2	11·1 ,,	—
10 ,,	0·01 grm.	2	8·7 ,,	21·8

The next experiments were with a different indigo solution: both the nitre and indigo solution were diluted to one-tenth their usual strength.

Nitre, one-tenth Normal.	Cane. Sugar.	Oil of Vitriol for 1 vol. of Mixed Nitre and Indigo.	Indigo required.	Reducing Effect of 100 of Sugar expressed in Nitre.
10 c.c.	None	1	12·9 c.c.	—
10 ,,	0·001 grm.	1	9·2 ,,	29·6
10 ,,	None	2	7·8 ,,	—
10 ,,	0·001 grm.	2	3·0 ,,	62·3

The reducing effect of the sugar is seen to be in all cases very considerable; it is much greater when 2 vols. of oil of vitriol are employed than when only 1 volume is used; it is also much greater in dilute than in strong solutions. The reason of the greater effect in weak solutions is probably the longer time available for the reaction. With a normal nitre solution the reaction with the indigo is practically over as soon as mixing is completed, but with a one-tenth normal solution the reaction will take more than half a minute. It is unfortunate that under the special conditions of water analysis organic matter will produce its greatest effect.

The object of the present investigation being to ascertain if the indigo method could be employed for determining nitrates in soil extracts, and in drainage waters, it was important to ascertain if the particular kinds of organic matter there present had a prejudicial effect. A kitchen-garden soil, rich in organic matter, was taken for the experiment. The nitrates in this soil had been previously determined by the mercury method employed by Frankland for water analysis; it was therefore possible, by calculation, to prepare an extract which should be of nearly the same strength as the normal nitre solution with which the indigo had been standardised; all errors of dilution were thus avoided, and the indigo method tried under the most favourable circumstances. As an example of an analysis by the indigo method, I will give the details of the experiment.

The watery extract from 60 grms. of air-dried soil was brought to 100 c.c.; the solution was amber-coloured, and slightly turbid. Successive experiments were made with 10 c.c. of this solution, till the maximum amount of indigo it required was ascertained. The indigo was in the first experiment run from a burette into the mixture of sulphuric acid and soil extract, but in the final trials the indigo was all added before the oil of vitriol. The proportion of oil of vitriol used after the preliminary trial was uniformly 1 volume.

Soil Extract.	Indigo added before Oil of Vitriol.	Oil of Vitriol.	Indigo added after Oil of Vitriol.	Total Indigo used.
10 c.c.	None	25·0 c.c.	10·4 c.c.	10·4 c.c.
10 ,,	11·4 c.c.	21·4 ,,	0·6 ,,	12·0 ,,
10 ,,	12·0 ,,	22·0 ,,	0·5 ,,	12·5 ,,
10 ,,	12·6 ,,	22·6 ,,	0·1 ,,	12·7 ,,
10 ,,	12·7 ,,	22·7 ,,	—	12·7 ,,
10 ,,	12·9 ,,	22·9 ,,	—	12·9 ,,
10 ,,	13·0 ,,	23·0 ,,	—	13·0 ,,

The maximum amount of indigo was reached when 13·0 c.c. were added.* A second extract of the soil residue required in all 1·0 c.c. of indigo. The nitrates in 6 grms. of soil were thus equivalent to 13·1 c.c. of indigo.

10 c.c. of nitrate solution, containing 0·010104 grm. of nitrate of potassium, required 13·6 c.c. of indigo, when 23·6 c.c. of oil of vitriol were employed. The percentage of nitrogen as nitrates in the soil was by calculation from these data 0·02246. The mean of two determinations by the mercury method gave 0·02224 per cent.

Another surface soil, analysed by the two methods, gave equally agreeing results. It appears, therefore, that the organic matter present in soil extracts, and probably therefore in drainage waters, has no appreciable effect on the result when the solution operated on is sufficiently concentrated, and when a minimum proportion of sulphuric acid is employed. A large series of soils and waters must, however, be examined by different methods before the results obtained with indigo can be considered as fully trustworthy.

In conclusion we will make a few remarks on the bearing of some of the facts now described upon the practical conduct of the method.

It is evident that results obtained by merely running indigo from a burette into a mixture of nitrate and sulphuric acid (the method of Marx, Trommsdorff, and Goppelsroeder) can only be exact under very exceptional

* This result might have been obtained in fewer experiments by greater boldness in the operator.

circumstances, and that to obtain constant results it is indispensable that all the indigo be present before addition of the oil of vitriol. It is also evident that the volume of oil of vitriol used must always bear the same proportion to the united volumes of nitre and indigo solution as in the experiment in which the indigo solution was standardised. When we come to the question, What is the best proportion of oil of vitriol to adopt? the answer becomes more difficult.

The various writers on the subject, from Marx to Sutton, all recommend the use of a double volume of oil of vitriol, without, however, offering any specific reason for the choice. We have seen that with this large proportion of sulphuric acid the errors caused, both by organic impurities, and by impurities in the acid itself, are at their maximum; evidence has also been adduced to show that with this proportion of acid the indigo scale has not the same value in every part. The use of a single volume of acid is free from the above objections; the bulk of indigo consumed is also much larger, and the range of tint in the final reaction is very short and good. The results are, however, much more dependent on manipulation, and to some extent on external temperature, than those obtained with greater volumes of acid; it is also essential in this case that the acid shall be of full gravity.

If only 1 volume of sulphuric acid is to be employed, it will suffice for most purposes to ascertain the freedom of the acid from nitrous and sulphurous impurities; acid sold as pure distilled oil of vitriol frequently contains one or other of these contaminations, and sometimes both. Nitrous impurity is easily tested for with indigo, the acid being mixed with distilled water. If the acid is mixed with water in the same proportions as will be used in subsequent experiments, the amount of indigo oxidised by a given volume of acid under these circumstances may be determined, and a correction subsequently made in every experiment, according to the volume of acid employed. If the acid oxidises indigo, the nitrous impurity is plainly in excess of the sulphurous, and the analyst need go no further. If the acid does not oxidise indigo, sulphurous acid must be looked for: this is best done by the test previously described (page 57). The methods of purifying oil of vitriol from sulphurous and nitrous acid have been already noticed.

If 2 volumes of sulphuric acid are to be used, all tests for impurity may be dispensed with, for a series of experiments must be made as to the value of different parts of the indigo scale; and these determinations will include all the errors introduced by the acid, if the same volume of nitrate solution be always employed. The experiments on the value of different parts of the scale are conveniently made by diluting the normal nitre solution to one-half, one-quarter, and one-eighth its original strength, and then ascertaining the amount of indigo required by the same volume of these various dilutions. These experiments must be renewed every time a fresh bulk of oil of vitriol is taken into use.

There is, however, one mode of proceeding by which the operator may become entirely independent both of impurities in the oil of vitriol and variations in the indigo scale. If the liquid to be analysed is concentrated or diluted till 10 c.c. require exactly the same quantity of indigo as 10 c.c. of any known nitre solution, it is evident that both solutions must contain the same quantity of nitrate, whatever may be the impurities in the oil of vitriol employed in both experiments.

New Colouring Matter Derived from Cresylol.—M. J. Annaheim.—If 100 grms. of cresylol from wood-tar, boiling about 202°, are heated with 40 grms. of fuming sulphuric acid for several hours to 100°, or rather to 120° to 130°, the product formed dissolves in acetic acid with a magenta colour. In alkalies it dissolves with a greenish blue colour, which quickly disappears.—*Les Mondes.*

A NEW AND ACCURATE METHOD FOR DETERMINING BOILING-POINTS WITH SMALL QUANTITIES OF LIQUID.

By P. T. MAIN.

By the boiling-point of a substance is meant the temperature at which the tension of its vapour is equal to the atmospheric pressure at the level of the liquid: the boiling-point of a given substance is thus a variable temperature, depending on the varying atmospheric pressure. In defining bodies by their physical characters it is usual to state these characters, when possible, with reference to standard conditions of pressure and temperature; thus a body is defined by its specific gravity and specific heat at a standard temperature, and by its boiling-point at a standard pressure. From this point of view we may define the boiling-point of a liquid as the temperature at which the tension of its vapour is equivalent to a pressure of 760 m.m. of mercury at 0° C. The problem of determining the boiling-point of a liquid resolves itself therefore into two problems:—(1), to make the tension of its vapour = 760 m.m.; (2), to determine the temperature at which it has this tension. Of these problems I have attempted a solution by a method which is, so far as I am aware, new, and which is susceptible—with an accurate barometer and a sufficiently delicate thermometer—of great accuracy with quite small quantities of liquid. My apparatus for this purpose consists of two principal parts—a boiling-tube and a pressure-tube. The boiling-tube is a thin, narrow, glass tube, V-shaped, hermetically sealed at its short end, and open at the long end; the short end may be about 2 inches in length, the long end about 18 inches: these dimensions I have found convenient in practice. The pressure-tube is a vertical glass tube, which can be connected with the open limb of the boiling-tube by a drying-tube, and which dips into water contained in a wider glass tube: by raising or lowering this wider tube, the pressure within the open limb of the boiling-tube may be made greater or less than the atmospheric pressure. The boiling-tube is held so that the bend of it is its lowest point: in this position the liquid to be operated on is distilled or poured into it in such quantity that on inclining the tube the air in the closed limb may be displaced by the liquid, which may be made to occupy the whole of this limb and a small portion of the open limb. By boiling this portion of liquid in the tube sufficiently, all dissolved air or gases may in general be expelled from the liquid, the space above which in the closed limb is then occupied by the vapour of the liquid only. The boiling-point of the liquid must be known or determined first approximately, which is easily done by a preliminary experiment; and we can then determine it accurately (if it is less than that of water) by immersing the boiling-tube in water at a temperature a little higher than the boiling-point of the liquid, connecting it with the pressure-tube, and increasing or diminishing the pressure by means of this so as to make it exactly equal to that of 760 m.m. of mercury at 0° C. By carefully lowering the temperature of the water till the liquid in the boiling-tube stands at exactly the same level in both limbs, and taking a few observations of the temperature while the liquid is steady in the boiling-tube or oscillating slowly about this mean position, it is possible to determine the boiling-point at 760 m.m., with considerable accuracy, with so little as 1 c.c. of liquid.

For liquids whose boiling-points are higher than that of water the process would necessitate the use of dense aqueous solutions, or of some other liquid which can be heated to higher temperatures than water without boiling or decomposing.

At present I have applied this method only to liquids whose boiling-points are lower than that of water.

I append the results of experiments on the following liquids:—Ether, chloroform, alcohol, tetrachloride of carbon, all of which were nearly pure to start with.

Ether.—Purified from water and alcohol by sodium till effervescence ceased; boiling-point, 34·8°.

Chloroform.—Purified from traces of water and alcohol by boiling with sodium till all action had ceased; boiling-points, 61·1° to 61·2°. These boiling-points were given by two portions, about 1 c.c. each, taken respectively from near the beginning and near the end of the distillate from 80 c.c. of chloroform purified by sodium. On two previous occasions portions of about 12 c.c. were taken and purified with sodium, and the boiling-point of the first distillate—about 2 c.c.—from each was found to be 61·15°. On another occasion the boiling-point of a portion of the undistilled and unpurified chloroform was found to be 61·3°; and again, 100 c.c. of the chloroform, before purification by sodium, were distilled, and portions—about 2 c.c. each—from the first, middle, and last portions of the distillate, gave respectively 61·1°, 61·2°, 61·5° as the boiling-points.

Alcohol (absolute) gave boiling-point 78·05°; after purification from traces of water by sodium, boiling-point 78°; again, a portion—about 130 c.c.—purified by quicklime gave as the boiling-points of portions from the beginning, middle, and end of the distillate, 78·1° in each case.

Tetrachloride of Carbon, unpurified and undistilled, gave boiling-point 76·3°; a first portion—about 3 c.c.—distilled from about 110 c.c. gave boiling-point 76·25°; a last portion from the same gave boiling-point 76·5°; again, about 15 c.c. were purified from traces of water and alcohol by boiling with sodium, and distilled; about 4 c.c. were taken of the first distillate, and gave boiling-point 76·5°; about the same quantity at the very end of the distillation gave boiling-point 76·6°.

Where I was uncertain about the reading of the thermometer—as, *e.g.*, whether it was 76·2° or 76·3°—I put it down as 76·25; but my thermometer was not divided so widely as to give exact readings to within less than 0·1° C.

The above determinations are, I believe, nearly exact, but my object in giving them is not to put them forward as accurate results, but as indicating, by the closeness with which they agree with each other for the same nearly pure liquid, the degree of accuracy which may be expected from the method when it is more matured.

At the present I have sufficient confidence in my results to say that the boiling-points are not in error by so much as three-tenths of a degree centigrade; and that, if there is an error of more than one-tenth of a degree, it is due not to any imperfection of the method, but to inaccuracy in the reading of the thermometer or of the barometer.

I hope before long to make some fresh determinations with more delicate thermometers.

The usual method for determining boiling-points is incapable of giving accurate results, for this reason—that it is impossible to secure that the vapour-tension of the liquid at the temperature observed differs from the atmospheric pressure at the level of the liquid by an inappreciable amount only. By my method it is quite possible, and not very difficult, to secure the fulfilment of this all-important condition.

St. John's College, Cambridge,
January 18, 1877.

THE PHILOSOPHICAL SOCIETY OF GLASGOW AND THE AMENDMENT OF THE LAW ON PATENTS FOR INVENTIONS.

THE Philosophical Society of Glasgow appears to have given very careful and prolonged attention both to the existing state of the Patent Law in Great Britain and Ireland, and to the proposals made during the last two sessions of Parliament for their amendment. The result of their deliberations has been the unanimous adoption of a memorial to the Lord Chancellor and a petition to both Houses of Parliament, for a copy of which we are indebted to the courtesy of Sir William Thomson.

We need scarcely say that a body like the Philosophical Society of Glasgow, comprising, as it does, numbers of eminent practical men, is very far from approving of the principles of the Bills of the last two sessions, almost avowedly designed to repress invention. The petitioners, though they pronounce no formal condemnation of these abortive measures, evidently hold that invention ought to be fostered, and that the rights of inventors to their own ideas should be fully recognised. They insist that the present scale of charges and fees is too heavy; they consider that the term of letters patent should be extended to at least twenty-one years, the present term of fourteen years being "too short for the development of by far the most important inventions or for the remuneration of the inventors." With this proposal we heartily concur, especially on account of its contrast with the clause of the Bill of last session, which gravely proposed that if a patent had not come into operation "on a reasonable scale" within two years, it should be regarded as void. Every practical man knows that except the patentee is a capitalist it is very rarely indeed that a new invention can be got into operation so early as the second year.

The petition before us does not take exception to the appointment of a Board of Examiners, but would not vest them with the power of rejecting applications. It is further proposed to abolish the "notice to proceed" as a mere costly and useless formality; to extend the time of payment of taxes "by allowing a certain period of grace within which they may be paid," and to maintain the present system of "Provisional Protection," which the measure of last year sought to abolish.

We think that the Glasgow Philosophical Society deserves great credit for having adopted this petition, and we hope that the example will be generally followed by similar bodies throughout the United Kingdom.

One point has possibly been overlooked. An English patent, under the "old law," extended to all the Sovereign's, "colonies, and plantations abroad," but not to Scotland and Ireland. The present law did away with the necessity of taking out three separate patents for England, Scotland, and Ireland, but by a most unfortunate blunder the colonies were omitted. Hence to protect an invention over the whole British empire costs at present above a thousand pounds sterling. We think that the amended Patent Law, if one is enacted, should at least take in India and all those colonies which have not separate legislatures of their own.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 1st, 1877.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, the following names were read for the first time:—Messrs. E. Hunter, F. C. C. Hewett, W. Terrill, A. Kinninmont, J. Borland, W. H. Griffiths, and G. A. C. Pearce. Messrs. Arthur Gaved Phillips and Ferdinand Kopfer were duly elected Fellows, after their names had been read the third time.

The PRESIDENT then gave notice that it was intended that the Fellows should dine together on March 20, and that they would shortly receive invitations. After the Anniversary Meeting a Special General Meeting would be held to consider the regulations for admission to the Associateship of the Society, and also an alteration in the form of obligation which the Fellows had to sign on entering.

The first paper was by Dr. H. E. ARMSTRONG, "*On Kekulé's and Ladenburg's Benzene Symbols.*" The speaker, after pointing out that although Kekulé's symbol had been used almost exclusively up to the present time, Ladenburg's "prism" formula merited more consideration than it had hitherto received, said that these two symbols were in accord in representing benzene as a symmetrical compound, *i.e.*, in which the six hydrogen atoms were of equal value. This consideration was supported, not only by the fact that no isomeric mono-derivatives of benzene had ever been obtained, but also by direct experimental evidence; for whichever hydrogen atom in benzene is displaced by the group OH, we always obtain the same phenol, as shown in the decomposition of the different oxy-benzoic acids and similar reactions. With regard to the di-derivatives of benzene, there is no ground for supposing that more than three isomeric forms can exist, and in this respect, also, the two symbols are identical with regard to the number of such isomerides which they indicate. It has been urged that one of the chief reasons for the adoption of Kekulé's symbol is that the formation of additive compounds is readily explained on the supposition that, when a molecule of a halogen unites with benzene, two adjacent carbon atoms united by a double affinity each unite with an atom of halogen, and thus remain united to one another only by a single affinity. Ladenburg's prism formula, however, lends itself to a similar explanation, with this difference, that it is the opposite carbon atoms in the ring previously united by a single affinity which unite each with a single atom of halogen, and at the same time cease to be directly united. After some observations on the difficulty of explaining the nature of the quinons, and on the influence a group exercises on others occupying the ortho or para position relatively to it, which could not be satisfactorily accounted for by the use of Kekulé's symbol, whilst Ladenburg's prism formula offered a possible explanation, the speaker expressed his opinion that the term para as applied to the di-derivatives of benzene should be limited to those which were capable of yielding but a single tri-derivative, whilst those which gave rise to two and three isomeric tri-derivatives should be called ortho- and meta-derivatives respectively. This nomenclature, being founded on experiment, was independent of any theoretical considerations as to the so-called "position" of the substituted groups. At present, although all known facts are in accordance with the supposition that the six carbon atoms in benzene and its derivatives are united in a closed chain, we do not in the least know in what manner the atoms are united: for this reason the simple hexagon now almost universally employed to represent benzene was preferable to the graphic formula consisting of six C's united in a hexagon by single and double lines alternately.

The PRESIDENT said they were all much indebted to Dr. Armstrong for the lucid manner in which he had discussed the relative value of the two graphic representations of benzene employed by Kekulé and by Ladenburg.

Dr. ODLING said that it was the custom of the Society not to publish communications of a purely theoretical character, but he hoped that in this instance the Publication Committee might be induced to depart from the rule, so that they might have the benefit of perusing Dr. Armstrong's useful *resumé* in the Society's *Journal*. He quite agreed with the speaker that the evidence was overwhelming as to the existence of but a single mono-derivative of benzene of each kind; also in rejecting that form of expression for quinons which represented them as containing oxygen united with oxygen. It was in the highest degree improbable that this could be the case, considering how totally different they were from those bodies which, like the peroxides, were supposed to contain oxygen united with oxygen. With regard to the employment of the symbols 1 : 2, 1 : 3, &c., he thought them preferable to the terms ortho, meta, and para, as these were employed in very different senses; Körner, for instance, who might be regarded as the most prominent representative of aromatic chemistry, used them in a very different sense from that in which they were ordinarily regarded. Moreover, there were numerous benzene compounds which at one time had been regarded as ortho and were now considered para or meta, and the same might be said of bodies formerly regarded as para or meta. For his own part he was in the habit of associating the various di-derivatives with the typical compounds, resorcin, pyrocatechin, and hydroquinon; for instance, those which could be converted into or were related to resorcin he distinguised by the prefix reso-, and so on.

Dr. WRIGHT thought they onght all to be thankful to Dr. Armstrong for the trouble he had taken in collating facts relative to these two symbols. There was an objection to the use of the terms meta and ortho in connection with the benzene derivative, inasmuch as they had long ago been applied to distinguish two of the phosphoric acids, the meta- being obtained from the ortho-acid by the abstraction of water, but nothing of the kind occurred in the case of the benzene compounds. He quite agreed with the speaker that these symbols should not be taken to represent any relative position of the atoms in benzene.

Dr. ODLING said he might perhaps be permitted to remark that the term meta was first used by Graham to indicate that meta-phosphoric acid still contained water, phosphoric anhydride being at that time regarded as the true acid; and he had advocated the view that those acids which had the full amount of base or basic water should receive the prefix ortho.

Mr. KINGZETT made some remarks on the benzene ring. He agreed with the view advocated by Dr. Armstrong that the six carbon atoms were united so as to form a closed chain. This afforded a means of explaining the different behaviour of phenose, $C_6H_6(OH)_6$, from that of the sugars, of which there were many having the same empirical formula $C_6H_6(OH)_6$. He had found that in certain reactions acetic acid could be substituted for sugar, and it was worthy of notice that if the formula of acetic acid, $C_2H_4O_2$, be tripled it is the same as that of sugar, $C_6H_{12}O_6$.

Dr. ARMSTRONG, in reply to a question put by Dr. Odling as to the difference in solubility in alcohol between ordinary potassic benzoate and that recently prepared by the action of alcoholic potash on benzoic aldehyd, first observed by Gregory, said that he did not know of any explanation of the fact. He also cautioned Mr. Kingzett against hastily drawing conclusions from the supposed constitution of phenose, as it was not by any means satisfactorily established that it had the formula assigned to it by Carius.

The next paper was by Mr. W. H. PERKIN, "*On the Formation of Coumarin, and of Cinnamic, and of other Analogous Acids from the Aromatic Aldehyds.*" The author, after adverting to a preliminary notice on the subject read before the Society in 1875, gave a brief account of some of the numerous substances he had obtained. He found that on boiling benzoic aldehyd with acetic anhydride and sodium acetate an action took place, with formation of an acid, which after purification was found to be identical with cinnamic acid. When sodium propionate and propionic anhydride were substituted for the acetate, *phenyl-crotonic acid*, $C_6H_5.C_3H_4.COOH$, was obtained. It crystallises in fine colourless needles, which melt at 82° to 84° C. *Phenyl-angelic acid*, $C_6H_5.C_4H_6$ COOH, was prepared in a similar manner by the employment of butyric anhydride. It crystallises in needles, which melt at 101° C. With succinic anhydride an acid was obtained having the same composition as phenyl-crotonic acid, but very different in properties; it has been named *isophenyl-crotonic acid*. Experiments were made in a similar manner with other aldehyds, namely, cuminic, cinnamic, anisic, and methyl-salicylic, which gave rise to sixteen other acids. It was found that the calcium salt of cumenyl-acrylic acid, obtained from acetic anhydride and cuminic aldehyd, when heated to 90° to 100° C., absorbed an atom of oxygen, and was converted into the calcium

salt of a new acid, which is now under investigation. Cumenyl-acrylic acid, also, when treated with sodium amalgam in the presence of water, takes up a molecule of hydrogen, giving rise to a crystallisable *hydro-cumenyl-acrylic acid*, which melts at 70° C. Cumenyl-acrylic acid when gently boiled undergoes decomposition, carbonic anhydride is eliminated, and a hydrocarbon,—

$$C_6H_4(C_3H_7)(C_2H_3)$$

isopropyl-vinyl-benzene, is formed. It is an oil boiling at 195° to 200°, and possessing a fragrant aromatic odour. The *methyl-para-oxy-phenyl-crotonic acid*, obtained from anisic aldehyd and propionic anhydride, under similar circumstances gave rise to anethol, $C_6H_4(OCH_3)(C_3H_5)$, whilst the corresponding acrylic and angelic acids gave rise to the homologous compounds, $C_6H_4(OCH_3)(C_2H_3)$ and $C_6H_4(OCH_3)(C_4H_7)$. By treating methyl-salicylic aldehyd with acetic, propionic, and butyric anhydrides, respectively, in presence of the corresponding sodium compounds, three acids were obtained, namely, *methyl-orthoxy-phenyl-acrylic acid*, or *methyl-coumaric acid*,—

$$C_6H_4(OCH_3)C_2H_2.COOH;$$

methyl-orthoxyphenyl-crotonic acid,—

$$C_6H_4(OCH_3)C_3H_4.COOH;$$

and *methyl-orthoxyphenyl-angelic acid*,—

$$C_6H_4(OCH_3)C_4H_6.COOH.$$

The methyl salt of an acid having the same composition as the first of these acids (methyl-coumaric acid) is obtained when the sodium derivative of coumarin, prepared by boiling it in alcoholic solution with sodium hydrate, is heated at 100° C. with methyl iodide. On saponifying the ether, it yields an acid isomeric with methyl-coumaric acid, and melting at 88° to 89°. The author calls it *a-methyl-orthoxyphenyl-acrylic acid*. This methyl salt, when heated at 150° C., undergoes isomeric change, and now, when saponified, yields an acid fusing at 182° to 183°, identical in all respects with that obtained from methyl-salicylic aldehyd and acetic anhydride. The fusible acid itself, also, when heated to its boiling-point, passes into the isomeric modification of higher fusing-point. The author described numerous salts of the various acids, also the acid chlorides and the amides, and concluded with some theoretical considerations as to the manner in which the acids are formed in this reaction, and their probable consitution.

The President, in thanking the author for his most interesting and important communication, said they would better be able to appreciate the immense amount of labour he had bestowed on this admirable investigation when they saw it in print. The meeting was then adjourned until Thursday, February 15, when the following papers will be read:—(1) "On the Estimation of Urea by means of Hypobromite," by Dr. Dupré; (2) "On the Influence Exerted by Ammonium Sulphide in Preventing the Action of Various Solutions of Copper," by Dr. T. Carnelly; and (3) "An Experimental Enquiry as to the Changes which occur in the Composition of Waters from Wells near the Sea," by Mr. W. H. Watson.

PHYSICAL SOCIETY.

February 3rd, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

The following candidate was elected a Member of the Society:—Mr. J. Norman Lockyer, F.R.S.

Prof. Osborne Reynolds exhibited a number of experiments in relation to vortex motion in fluids. They have been gradually developed during the last few years, but are still in a very incomplete state, and he hopes that others will join him in the enquiry. Probably the reason why so little progress has been made in the determination of the elementary laws of fluid-motion is that mathematicians have been without experimental data on which to found their calculations. The well-known rings formed by a puff of smoke have been studied by many high authorities, but not with a view to their general bearing on this subject. Prof. Reynolds first showed smoke-rings and their interference by means of the apparatus devised by Prof. Tait, and added that although the theory of smoke-rings does not imply that vortex motion is peculiar to vapours, their existence in liquids was only pointed out by Mr. H. Deacon at a comparatively recent date. In studying the action of the screw-propeller Prof. Reynolds noticed the systematic manner in which the form of a disk moved obliquely through water is retained by the track of air which it produces. If a flat disk be supported on a light frame, and caused to move rapidly through water, the motion ceases on withdrawing the hand suddenly, but if this be done gradually the motion continues. By passing a coloured liquid down a fine tube to the back of the disk he found that a vortex ring is always formed, which passes to the rear of the disk, and the same effect is produced by dropping water from a height into water covered with a coloured liquid. In a trough about 6 feet long, and at one end of which was a horizontal tube closed with sheet india-rubber, air-rings were formed by introducing air into the tube, and then striking the india-rubber externally by means of a flat board, and it was shown that a ring is capable of propelling a vane placed in its course, to the front of which it never advances. If the air be replaced by a coloured liquid the ring travels with considerable velocity, and the motion of a solid body of the density of water is is no degree comparable. If a ring travels through a part of a liquid which has previously been coloured it causes no motion of translation, and Prof. Reynolds concludes that no resistance is offered to their motion. Nevertheless, the motion is gradually stopped, but the ring is constantly enlarging by gathering water as it travels, and its momentum remains nearly constant. After adverting to the methods adopted to ascertain the direction and velocity of motion, the initial form of the rings was shown to be a spheroid. A solid of this form, however, is very slow in its passage through water, and he considers this to be due to friction. He has succeeded in imitating the form of the ring by causing a disk surrounded by pieces of ribbon to move through water. Finally, Prof. Reynolds referred to Sir William Thomson's researches on the interference of two rings, and showed that the oscillating rings so produced can be formed in liquids by employing an oval in place of a circular aperture.

The Annual General Meeting of the Society was then held.

The President read the Report of the Council, of which the following is a brief abstract:—The Council points with satisfaction to the number and interest of the papers read before the Society, and a brief summary is given of the more important. The Society has to regret the loss of three of its members, Mr. David Forbes, F.R.S., Mr. A. S. Hobson, and Mr. Arthur Pinn. The publication of a new edition of Prof. Everett's work, and of a complete edition of Sir Charles Wheatstone's writings, is announced, and the Council hopes shortly to undertake the translation of scientific papers from foreign sources, to be published in its *Proceedings*.

The following Officers and Council were elected for the ensuing year:—

President—Prof. G. C. Foster, F.R.S.

Vice-Presidents—Profs. W. G. Adams, F.R.S., and J. H. Gladstone, F.R.S.; Mr. W. Spottiswoode, LL.D., F.R.S.; Sir W. Thomson, LL.D., F.R.S.; and Dr. W. H. Stone.

Secretaries—Prof. A. W. Reinold and W. C. Roberts, F.R.S.

Treasurer—Dr. E. Atkinson.

Demonstrator—Prof. F. Guthrie, F.R.S.

Other Members of Council—Prof. W. F. Barrett, Latimer Clark, Major Festing, W. Huggins, D.C.L.,

F.R.S., Prof. Kennedy, O. J. Lodge, Prof. H. Macleod, Prof. B. Stewart, LL.D., F.R.S., Prof. Unwin, and E. O. W. Whitehouse.

The proceedings terminated with votes of thanks to the Lords of the Committee of Council on Education for the use of the Physical Laboratory at South Kensington, and to the several Officers of the Society.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 9, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Poisonous Properties of Yew-Leaves*," by JAMES BOTTOMLEY, D.Sc.

In the *Field* for December 23rd is a letter from Professor R. V. Tuson, relative to the poisonous action of yew-leaves on pheasants. At the end of his letter he promises to make an examination of the toxic properties of this tree, which up to the present time do not seem to have been fairly investigated. In November, 1871, a similar case came under my notice. A number of pheasants were found dead on the estate of Mr. Baring, in Hampshire. Four of the birds were sent to me for examination. Three of them contained in their craws considerable quantities of yew-leaves along with grain. The craw of the fourth bird contained neither grain nor yew; there was only a little mucus, distended with bubbles of air. The yew had no doubt passed into the alimentary canal and could not be very distinctly recognised. In the course of the investigation I found that apart from botanical characteristics the yew could yield well-marked chemical reactions. It became necessary to subject yew leaves to the same process as would be used to separate strychnine from animal tissue, the ethereal extract finally obtained having been evaporated to drive off the ether. There remained on the evaporating basin a thin varnish-like residue which was very bitter to the taste. When treated with cold nitric acid this residue assumed a dark blue colour like indigo. Upon the application of heat the colour disappeared.

"*On the Luminous Sulphides of M. Ed. Becquerel*," by WILLIAM THOMSON, F.R.S.E.

My object in bringing this communication before the Society is to show what I consider to be some most interesting substances, viz., the sulphides, principally of the alkaline earths, the luminous properties of which were studied many years ago by M. Edmond Becquerel and others. These samples which I have I received some time ago when in Paris through my friend M. Auguste Guerout, Prèparateur au Muséum d'Histoire Naturelle. They were prepared by M. André, the laboratory assistant of M. Ed. Becquerel, who has devoted much attention to the peculiarities of manipulation required to produce the greatest degree of luminosity in the sulphides after holding them for a few seconds before the sun's light, or a piece of burning magnesium wire or other source of light, and then placing them in the dark; doubtless many present will be familiar with the results arrived at by Becquerel and others, but a short résumé of some of them may not be out of place here.

When these sulphides, which must be kept in hermetically sealed tubes to prevent oxidation, are exposed to the rays at different parts of the spectrum, these rays have very different actions in rendering the sulphides luminous, and also in some cases of producing slightly different shades of colour. The visible part of the spectrum has little or no power to render these bodies phosphorescent, the violet part, however, has greatest action, and the ultra-violet rays produce the maximum effect. M. Becquerel found then, in these sulphides, an interesting method of examining the invisible parts of the spectrum, which furnished an addition to those employed, viz., the thermometer, silver compounds, &c.; these sulphides may be compared to chords which have the power of absorbing vibrations whose wave lengths are too small to affect the organs of hearing—too shrill to be heard—and of changing them into vibrations of greater wave-lengths, and emitting them, so that they may be distinctly heard.

When these sulphides are held before some source of light, the sun's rays for instance, and then placed in a dark room, they gradually, after many hours, lose their phosphorescence—if, however, they be then heated a few degrees above the temperature at which they have remained, say from 60° to 80° F., they again become faintly luminous, and if kept for some time at that temperature they gradually lose their phosphorescence again; if allowed then to cool in the dark to 60° F., and again heated to the same temperature they show no phosphorescence, but if heated to a still higher degree of temperature, say 100° F., they again become luminous, and so on; this power may be regained and lost any number of times by placing them for a few seconds before any bright source of light and then removing them to a dark room—an electric current from a Ruhmkorff's coil passed through vacuum tubes containing these sulphides also develops their different colours.

The interesting point with respect to the sulphides which I show here this evening, is that they have been prepared by a special mode of manipulation by M. André, and that the luminosity or phosphorescence capable of being produced by them is greater than that from any which hitherto have been prepared.

The following gives the compositions of the different sulphides which show the differently-coloured phosphorescences:—

Green is composed of sulphide of calcium.

Orange is composed of sulphide of calcium which has been heated with 1 or 2 per cent of binoxide of manganese.

The lime for the preparation of the above-mentioned two colours was produced by the calcination of oyster shells.

An orange-coloured phosphorescence is also produced by sulphide of barium.

Blue and *Violet* are each sulphides of calcium which have been prepared from precipitated carbonate of lime.

Yellowish Green is simply sulphide of strontium.

Yellow is sulphide of strontium which has been calcined with 4 or 5 per cent of sulphide of antimony.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

January 29th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

AT the opening of the session, the presiding officer paid a brief tribute to the memory of the late Prof. J. C. Poggendorf, the editor of the well-known *Annalen der Physik und Chemie*, who died in Berlin, January 24th.

A. PINNER read a communication from V. MEYER "*On Cuminol*," in which it was stated that if perfectly pure it did not yield cymen upon treatment with caustic potash, as given in Kraut's investigations upon the subject. The latter's researches were probably made with cuminol which had not been entirely freed from cymen.

R. MÜNKE exhibited a new rotatory aspirator, in which the necessity of changing the connecting tubes by each inversion was obviated; and some improvements in the methods for heating the air and gas supplied to a blast lamp.

C. CECH and P. SCHWEBEL described "*A Peculiar Formation of Iso-cyano-benzene*." Dichlor-acetate of aniline upon treatment with caustic soda is changed almost entirely into iso-cyano-benzene and formic acid—

$$Cl_2HC-COOH.C_6H_5NH_2=CNC_6H_5+2HCl+CH_2O_2.$$

M. Klobukowski gave the results of experiments upon the method of E. Kopp, proposed a short time since, for the "*Determination of the Halogens in Organic Compounds.*" The process consists in heating the mixture of the substance to be analysed with ferric oxide, in a narrow glass tube, the remainder of which is occupied by a spiral of fine iron wire and a layer of carbonate of sodium. It was found that by using a tube of Bohemian glass, 60 c.m. long and 5 to 6 m.m. in diameter, the combustion was ended in five to ten minutes, and that the easiest way of bringing the contents of the tube into water was to dip its lower end while still hot into a deep beaker containing a little cold water. The method is to be recommended on account of its rapidity and accuracy, as well as the ease of obtaining perfectly pure Fe_2O_3 for the purpose.

F. Tiemann and H. Herzfeld stated that by treatment of salicylic aldehyd with sodium acetate and acetic anhydride they had obtained "*ortho-coumaric acid*," $C_9H_8O_3$, in a manner analogous to the formation of para-coumaric acid from para-oxy-benzoic aldehyd. The acid is separated out in the form of the acetyl compound by solution in ether and treatment with carbonate of sodium. The melting-point of coumaric acid obtained in this way as well as by the ordinary method, is found to be 195°, instead of 207° as given by Perkin.

S. Gabriel read a paper "*On Meta-sulpho-cyanate of Phenylen*," $C_6H_4(SCN)_2$, which was obtained by the action of ICy on phenylen sulphhydrate in closed tubes. It crystallises in short needles, melts at 54°, and is changed by nitric acid and sulphuric acid into nitro-sulpho-cyano-phenylen, $C_6H_3.NO_2.(SCN)_2$—yellow needles melting at 150°.

The same author also read a paper "*On Ethers of the Tribasic (Ortho) Thio-formic Acid.*" Ortho-thio-phenylic formiate, $CH(SC_6H_5)_3$, is obtained by the action of chloroform upon sodium phenylic mercaptide, and ortho-thio-ethylic formiate, $CH(C_2H_5S)_3$, from the corresponding ethylic compound; the former crystallises in thick prisms; the latter is a liquid, boiling under partial decomposition between 200° and 250°, and possessing a most offensive odour.

Prof. Hofmann stated that *a triphenyl-guanidin* was easily obtained by the action of carbon tetrachloride upon aniline in open flasks, without having recourse to the more complicated method given at the time of its discovery.

The same author described also some experiments on the composition and preparation of a new orange colouring matter, called "*chrysoidin*," which has lately appeared in the market. Analysis proved this body to be the hydrochlorate of diamido-azo-benzene, $C_{12}H_{12}N_4$, thus placing it midway between aniline yellow (mono-amido-azo-benzene) and phenylen brown (triamido-azo-benzene).

Aniline yellow, $C_{12}H_9NH_2.N_2=C_{12}H_{11}N_3$.
Chrysoidin, $C_{12}H_8(NH_2)_2N_2=C_{12}H_{12}N_4$.
Phenylen brown, $C_{12}H_7(NH_2)_3N_2=C_{12}H_{13}N_5$.

Chrysoidin is easily obtained by submitting the diazo-benzene of P. Griess to the action of phenylen-diamin—

$$C_6H_4N_2+C_6H_8N_2=C_{12}H_{12}N_4.$$

The phenylen-diamin to be used is the one yielded by reduction of dinitro-benzene. The isomeric compound prepared from aniline yields no colouring matter. A series of analogous colouring matters may be obtained by submitting the azo-fulminates of aromatic monamines to the action of diamines.

F. Tiemann and B. Mendelsohn read a paper "*On the Components of the Creosote obtained from Beechwood Tar.*" The fraction of the acid oil of this creosote boiling at 220° consists chiefly of creosol and phlorol, and the relations of these two to other well-known compounds have been examined. Creosol has been changed first into an acetyl compound, and then by oxidation into vanillic acid, and receives, therefore, the structural formula $C_6H_3(CH_3)(OCH_3)(OH)$, the sidelinks in the order 1, 3, 4. Phlorol was changed first into methyl-phlorol, and this was oxydised to an oxyphthalic acid, identical with that obtained from salicylic acid. Phlorol is therefore to be regarded as an oxy-xylen, $C_6H_3(CH_3)_2(OH)$.

The following papers from non-resident members were read:—

H. Wald, "*On Para-dinitro-diphenyl.*" On treatment with sodium amalgam 2 molecules of this compound unite together, under separation of 3 atoms of oxygen, forming an azo-oxy-nitro-diphenyl.

A. Baeyer, "*On Phenanthren-quinon.*" By boiling with soda this body takes up a molecule of water, and forms an aldehyd acid of the formula $C_{14}H_{10}O_3$.

T. Heymer, "*Action of Sodium on Succinic Ether, and a Peculiar Formation of Hydroquinon.*" By the action of sodium a complicated ether, analogous to aceto-acetic ether, is produced. If treated with soda and sulphuric acid while protected from the action of the air, it yields hydroquinon. With acetic acid, and an incomplete exclusion of air, an acid of the following composition is obtained:—$C_6H_4O_2(COOH)_2$.

A. Baeyer, "*On Aldehyds of the Phthalic Acids.*" The author obtains them from the acid chlorides by treatment with hydriodic acid and phosphorus.

J. Berger, "*On Oxy-terephthalic Acid.*" This compound, $C_6H_3(OH)(COOH)_2$, was obtained from the diamido compound, and gives with HCl oxy-salicylic acid.

F. C. Muller, "*On the Temperature of Aqueous Vapour under Normal Conditions.*" Experiments show that there is no condensation of water upon the bulb of a thermometer surrounded by aqueous vapour and marking 100°, if it be previously warmed to that temperature, and condensation upon the upper part of the tube be prevented.

C. Göttig, "*On the Synthesis of Aldehyds.*" The author applies successfully the method of distillation of calcium formiate with the calcium salt of the corresponding acid to the synthesis of ethyl-salicyl-aldehyd,—

$$C_6H_4(OC_2H_5)(COH),$$

but is unable to obtain salicyl-aldehyd itself.

H. Schwanert, "*Dinitro-toluen-sulphonic Acids.*" The author has obtained two isomeric acids of this composition, $C_6H_2(CH_3)(NO_2)_2(SO_2H)$, one of which, dinitro-para-toluen-sulphonic acid, derived from ortho-nitro-para-toluen-sulphonic acid by the action of HNO_3, is described fully. A number of salts, the amide, chloride, and various compounds with acids, are also described.

A. Bernthsen, "*Action of Nascent Hydrogen upon Benzo-thiamide.*" Sodium amalgam in an alcoholic solution reduces benzo-thiamide to benzo-thialdehyd, $C_6H_5.CSH$.

B. Zöller, "*On the Conservatory Properties of Potassic Xanthate.*" A small addition of this salt is found sufficient to prevent decay and fermentation in organic bodies for an indefinite period. The juice of the grape and other fruits can be preserved in this way perfectly fresh, even when exposed to the air. On account of its cheapness, easy application, absence of dangerous properties, and the small amount required, potassic xanthate can well replace many conservatory substances at present in use.

A. Raab, "*On some Derivatives of Cuminic Aldehyd.*" Among these are dicuminyl-carbamide, $CO(NHC_{10}H_{13})_2$, dicuminyl-sulpho-carbamide, and hydro-cuminoïn, $C_{20}H_{26}O_2$. The latter was obtained by reduction of the aldehyd with nascent hydrogen, and gives acetyl-, chloro, and other derivatives.

K. Stuckenberg, "*On Para-nitro-ortho-sulphi-phenol.*" This body has been obtained in the form of the calcium-salt, $C_6H_3NO_2SO_2OCaO$, by the action of nitric acid upon the potassium salt of ortho-sulphi-phenol.

B. Radziszewski, "*On the Phosphorescence of Lophine, Amarine, and Hydro-benzamide.*" The author has found that if lophine is dissolved in an alcoholic solution of potassic hydrate an exceedingly brilliant phosphorescence takes place. An extensive series of experiments showed that the phenomenon did not occur in other solutions of lophine, or by the action of heat or friction; also that it was partially due to a slow process of oxidation, although

not entirely. Ammonia and potassic benzoate were the decomposition-results of the reaction. Amarine and hydro-benzamide displayed the phenomenon under the same conditions, but much less brilliantly. The author attributes it to causes analogous to those inducing the phosphorescence of phosphorus itself.

R. STRUVE, "*Derivatives of Phenanthren.*" The author has obtained from phenanthren-quinon dinitro-phenanthren-quinon, a heavy yellow powder, and changed this by oxidation into dinitro-diphenic acid,—

$$C_{12}H_6(NO_2)_2(COOH)_2.$$

Reducing agents yield a diamido-diphenic acid, a white amorphous powder, the hydrochlorate of which gives by distillation with soda-lime diamido-diphenyl.

CORRESPONDENCE.

DOCTOR'S DIPLOMAS.

To the Editor of the Chemical News.

SIR,—Dr. P. Townsend Austen calls attention to an advertisement which is appearing in the *Kladderdatsch*, offering degrees for sale, Ad., Medicus, Royal Square, Jersey, England.

The degrees emanating from this source are not English degrees, but degrees from the "University of Philadelphia," and have been very frequently exposed in the papers here.

As these bogus degrees are by this time too well known in this country to be profitable, the enterprising advertiser is probably trying them on in Germany.—I am, &c.,

A. A. R.

London, February 5, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 4, January 22, 1877.

Memoir on Electro-Capillary Actions, Treating of (1) the Depolarisation of the Electrodes, as well as of the Electric Effects Produced at the Point of Contact of the Membrane and of Various Liquids; (2) the Relations between the Electromotive Forces, the Quantities of Heat Liberated during their Production, and the Diffusive Powers.—M. Becquerel.—The nature of this paper appears sufficiently from the title. The author considers that he has arrived at a more exact determination of the electro-motive forces, and a more complete study of the intervention of electro-capillary actions in the phenomena of life.

Researches on the Substituted Eugenols.—M. A. Cahours.—The author has obtained and studied propyl-eugenol, $C_{26}H_{18}O_4$, a mobile liquid of a pale amber colour, with an odour recalling that of the carnation, insoluble in water, readily soluble in ether, boiling between 263° and 265°, and of the specific gravity 1·0024. Iso-propyl-eugenol boils between 252° and 254°, and its specific gravity is 0·199 (?). Butyl-eugenol, $C_{24}H_{16}O_8$, boils between 272° and 274°, and of specific gravity 0·985. It may be regarded as methyl-butyl-proto-catechuic acid. Amyl-eugenol, $C_{30}H_{22}O_4$ (amyl-methyl-proto-catechuic acid), boils between 283° and 285°, and its specific gravity is 0·976. Hexyl-eugenol boils between 296° and 300°. Allyl-eugenol, $C_{26}H_{16}O_4$, boils between 267° and 270°, and has the specific gravity 1·018. The author has also obtained benzyl-eugenol and ethylen-eugenol.

Contemporaneous Formation of Zeolites (Chabasie and Christianite) under the Influence of Hot Springs in the District of Oran, Algeria.—M. Daubrée.—In certain fragments of Roman masonry, consisting of lime cementing together fragments of brick, were found zeolitic crystals of the kinds just mentioned.

Capacity of Saturation of Manganous Acid.—M. A. Gorgen.—The author concludes that the binoxide of manganese at the moment of its formation is a bibasic acid. The other manganites of the formula $(5MnO_2)RO$ are not saturated manganites, but manganites in equilibrium with reference to the medium in which they have taken their origin. The hydrated binoxide of manganese prepared artificially may be regarded as a modification of manganous acid in the nascent state.

Action of Heat on Quercite.—M. L. Prunier.—In the first stage which extends to +280° in a vacuum the substance loses water, and there are formed neutral compounds, among which is found a volatile body, quercitic ether. All the compounds formed are neutral, soluble in water, insoluble in alcohol and ether, and regenerate quercite if boiled in water. Above 280° to 300° the molecule is abruptly broken up; carbonic acid escapes, and there are formed crystalline acid bodies, more volatile and more fusible than quercitic ether.

Fermentation of Urine.—Dr. C. Bastian.—A continuation of the controversy with M. Pasteur.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 35, November, 1876.

Note on the Nickel Extracted from the Ores of New Caledonia.—MM. Paul Christofle and H. Bouilhet.—The substance of this paper has been already inserted in the CHEMICAL NEWS.

No. 36, December, 1876.

Report made by M. Lamy on behalf of the Committee of Chemical Arts on the Distilling and Rectifying Apparatus of MM. Savalle, Fils, and Co.—It is impossible to give an intelligible account of the apparatus employed by the inventors without the accompanying illustrations.

Report made by MM. Cloëz and De Luynes on behalf of the Committee of Chemical and Economical Arts on the New Saccharimeter of M. Laurent.—The apparatus is arranged like the polariscope of Mitscherlich, from which it differs merely in the construction of the polariser. It consists of a combination equivalent to two Nicol prisms in juxtaposition, of which the principal sections form an angle of 5°. A full description of the apparatus would require the aid of illustrations.

Les Mondes, Revue Hebdomadaire des Sciences, December 14, 1876.

According to M. Legrand there are grievous complaints concerning the defective ventilation of the hall in which the Academy of Sciences holds its meetings. The evil is aggravated by the fact that a certain illustrious physiologist has a great dread of an open window.

Composition of the Baths for Tempering Glass.—In water the glass almost invariably breaks. Fatty matters perfectly purified, and virgin oils free from all admixture, give good results. The temperature employed varies from 150° to 300°. Glycerin, whether pure or mixed with fats, cannot be advantageously employed.

December 21, 1876.

This issue contains nothing of interest save a paper by M. Recamier on the "Action of Light as a Motive Power," which we shall endeavour to reproduce in full.

MEETINGS FOR THE WEEK.

MONDAY, 12th.—London Institution, 5.
—— Medical, 8.
—— Royal Geographical, 8.30.
TUESDAY, 13th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Anthropological Institute, 8
—— Photographic, 8. (Anniversary).
WEDNESDAY, 14th.—Society of Arts, 8.
THURSDAY, 15th.—Royal, 8.30.
—— London Institution, 7.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Chemical, 8. "On the Estimation of Urea by means of Hypobromite," by Dr. Dupré, F.R.S. "On the Influence of Ammonium Sulphide in Preventing the Action of various Solutions on Copper," by T. Carnelly. "An Experimental Enquiry as to the Changes which Occur in the Composition of Waters from Wells near the Sea," by W. H. Watson.
FRIDAY, 16th.—Royal Institution, 9. "Solid Water," by Prof. F. Guthrie.
—— Geological, 1. (Anniversary).
SATURDAY, 17th.—Royal Institution, 3. "Florence and the Medici," by J. A. Symonds.
—— Physical, 3.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 899.

QUANTITATIVE ANALYSIS OF CERTAIN METALS IN IRON AND STEEL.

By SERGIUS KERN, St. Petersburg.

In several specimens of analysed hard steels from 0·3 to 0·5 per cent of tungsten was detected. The specimens in hand were received from Sweden as steel for instruments, especially for files. In analysing this steel for tungsten it was found very troublesome to evaporate to dryness the ammoniacal solution of tungstic acid, as the boiling liquor is very often thrown out from the beaker. The following alteration in this process was found to be very practical:—

5 grms. of the specimen are dissolved in aqua regia, and the solution is evaporated to dryness, and then dissolved in a mixture of 25 c.c. of water and 15 c.c. of hydrochloric acid. The resulting precipitate contains silica and tungstic trioxide (WO_3); it is next filtered from the solution, washed first by water acidulated by 5 per cent of hydrochloric acid, and finally by pure alcohol. The tungstic trioxide is dissolved on the filter in strong ammonia; the filtrate is boiled for twenty minutes with 5 grms. of caustic lime or caustic potash; hydrochloric acid is next added, the solution is heated for some time, and the remaining precipitate of pure tungstic trioxide is filtered from the liquor, dried on the filter, carefully ignited, and weighed. WO_3 contains 79·31 per cent of tungsten.

Having made several new experiments with *chromeisen* prepared by the process described in my article in the CHEMICAL NEWS (vol. xxxii., p. 136), I may strongly recommend the use of it in steel manufacture instead of spiegeleisen and ferro-manganese. The resulting steel is very soft and is far superior to the steels now in use for the preparation of boiler plates, tyres, guns, wire, &c. In preparing such cast-steel in every crucible, containing ordinarily 70 to 80 lbs. of raw material, 0·75 to 1·60 per cent of chromeisen containing 50 to 60 per cent of metallic chromium is added. In analysing the resulting chrome-iron alloys the following process may be used. The work is quickly executed:—

From the solution containing iron and chromium, these metals are precipitated by ammonium sulphide $[(NH_4)_2S]$; the resulting precipitate is filtered from the liquor, dried, and ignited for 30 to 40 minutes in a platinum crucible with 4 parts of a mixture of equal quantities of KNO_3 and K_2CO_3. The ignited and fused mass is placed in a glass, and hot water with 5 per cent of alcohol is next added. The liquor is boiled and filtered from the precipitate; the solution contains only the chromium salt, which is precipitated by adding an excess of ammonia in the form of chromium hydrate ($Cr_2O_6H_6$), which is strongly ignited; the resulting chromium oxide (Cr_2O_3) is weighed and the percentage is calculated knowing that this compound contains 32·2 per cent of chromium. In analysing iron and steel the manganese is usually separated from the iron by sodium acetate, which throws down the iron and leaves the manganese in solution, which is precipitated either by ammonium sulphide in the form of manganese sulphide, or by bromine in the form of hydrated manganese dioxide ($3MnO_2+H_2O$), which is next ignited, and the resulting manganese compound, manganomanganic oxide (Mn_3O_4), is weighed. The first process of precipitation of manganese by $(NH_4)_2S$ is, however, a dirty operation, giving at the same time not such correct results as the bromine process. But as bromine is expensive the use of it in laboratories is limited. The strong irritating smell is also a drawback in using this element for analytical researches. I propose to replace the bromine in this case by sodium hypochlorite, which, in solutions of manganous salts in the presence of an alkali, throws down the manganese in the form of hydrated manganese dioxide by the following equation:—

$$MnCl_2+NaOCl+2NaHO=(MnO_2+H_2O)+3NaCl.$$

The sodium hypochlorite may be easily prepared and is cheap.

Obouchoff Steel Works, St. Petersburg.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 50.)

Manufacture of Sulphuric Acid. By ROBERT HASENCLEVER, Manager of the Stolberg Works.

If the slope of the ground permits no other arrangement the waggons may have a low shape, and the tram-way may be on the same level as the floor of the furnace. At the Rhenania and in other places where the pyrites can be brought up on to the kilns without difficulty, the charge of lump-ore is introduced through an aperture in the vault, and the process does not take more than 20 seconds. If it is too difficult to convey the ore upon the top of the kilns it is thrown in with shovels through the working door. In this manner 400 kilos. can be introduced in five minutes. As charging always disturbs the progress of the furnace it is advisable to restrict it to a minimum of time.

Poor lump-ores are roasted in Freiburg and Oker in small shaft furnaces with a lateral exit for the gases, and a low vault in which a high layer of ore is constantly maintained.†

As for the roasting of smalls and rough fragments it is sometimes carried on along with the lump-ores. This method is not advantageous, and renders the burning of the whole of the pyrites imperfect.

It is better to work up the smalls into balls (Klütten, Stöckeln, *Boulets*).

For this purpose they are mixed with more or less clay and water, and moulded into balls or cut in pieces. The dried balls are then burnt either alone, or mixed with lump-ores in the kilns described above. English establishments which burn Spanish cupriferous pyrites mix the finely ground ore with water without clay, and mould the paste into balls, which hold together owing to the presence of vitriol.

For roasting smalls and coarse powder several kilns have been latterly proposed.

In 1862 the so-called shooting-kilns were introduced at Freiberg, their original and ingenious construction being due to Moritz Gerstenhöfer. They have been described in most technological journals, and in Schwarzenberg's "Treatise on the Manufacture of Sulphuric Acid" (p. 415), they are represented in figures drawn to scale. F. Bode, assistant in Gerstenhöfer's technical office, describes them in detail in his pamphlet "Contributions to the Theory and Practice of the Manufacture of Sulphuric Acid."‡ He deals at length with all the objections to Gerstenhöfer's furnaces, and endeavours to refute them.

The ores to be burnt in Gerstenhöfer's kilns must first be ground to a fine powder. They are desulphurised whilst falling down a shaft of about 5 metres high, 1·25 metres wide, and 0·8 metre deep. This shaft is fitted up with three-sided prisms of fire-clay, arranged with one

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Compare Graham-Otto's *Lehrbuch*, Band 2, abth. 1, 549.

‡ "Beiträge zur Theorie und Praxis der Schwefel Säure Fabrication."

angle downwards and one side upwards so that intervals remain between them, and the particles of ore fall from one prism to the next. The raw ore is introduced continuously by means of a hopper, and the burnt residue is withdrawn from time to time below. The furnace is heated with wood or coal previously to entering the ores, and as soon as they are introduced the fire is withdrawn, as the combustion of the sulphur keeps up the necessary temperature. Rich ores are passed through the kilns in small quantities and poor ores more rapidly.

Instead of putting in furnace bars below and removing them again when the kiln is warm, the author introduced a permanent lateral fire in the Gerstenhöfer kilns built at Stolberg, which was ready for use on a change of ores or any interruption of the process. In Stolberg the burnt ore, also, was drawn at once out of the furnace into a truck, introduced below the bottom sliding plate. Both these arrangements were considered by Bode as improvements.

Gerstenhöfer's kilns afford the great advantage that poor ores may be burnt without the aid of fuel, so as to produce rich gases of a constant composition and fit for the chambers. If perfect burning is not required they are unequalled. At Vedrin, in Belgium, where the good pyrites are sold and only the inferior qualities are used for the preparation of acid, satisfactory results are obtained with them, as also in Freiberg, where a mere preliminary roasting of mixed ores is required.

For roasting rich smalls this furnace has not come into general use, and is employed neither in France nor in England (except for copper-ore at Swansea). It has been abandoned at the chemical works at Chauny (Dep. Aisne), of Widnes (Lancashire), of Nienburg on the Weser, and of Stolberg, on account of imperfect burning and excessive production of flue-dust.

A furnace for smalls invented by Perret was shown as a model at the Paris Exhibition of 1867, and has been fully described by Schwarzenberg.* This furnace consists of several stages of horizontal plates arranged above a kiln for lump pyrites. These plates are fixed at intervals of 30 centimetres, and are covered with smalls to the depth of 5 to 8 centimetres. The hot gases from the kilns below sweep over them whilst ascending, and exhaust them of sulphur. Perret's furnace has been in action for years in the Wohlgelegen Chemical Works, near Mannheim, but otherwise it has remained confined to France. As originally designed it rose to the height of 6 metres above the furnace, and required much labour, as the ores had to be pushed up from stage to stage, whereby also some sulphurous acid escaped. The most recent Perret furnaces are essentially modified and act very satisfactorily. They are a little above 2 metres in height, and have only four ranks of plates, which can all be charged from the level of the furnace. The ore burns clean on every plate, and does not require to be pushed up from below. In this manner equal weights of lump and smalls are burnt.

Maletras, of Rouen, set up a plate furnace on Perret's principle, in which rich smalls are thoroughly roasted alone without lumps, and without the aid of coal. Similar kilns are in use at Dieuze and near Berlin. The roasting of poor smalls at Dieuze has proved unsatisfactory, although the ore was dried before charging the furnace. Smalls of 46 to 48 per cent of sulphur were burnt down to 3 or 4 per cent.

In 1861 Peter Spence patented a furnace in England† similar to those which had been in use for twenty years in Belgium, and at Stolberg, near Aachen. The furnace was worked with fuel, which heated a muffle, constructed of arches, for the reception of the ores. Much air entered through the working doors, so that the gases contained but little sulphurous acid. A kiln of this kind is still in use at the Works at Imeary, near Newcastle-on-Tyne. In Spence's establishment it has fallen into disuse, and has altogether found but a very limited application.

* Bolley, "Handbuch der Chem. Technologie," ii., 421.
† A.D., 1861. Specification No. 3002.

Allhusen, of Gateshead, burns smalls on iron plates above the lump pyrites. Nothing has transpired concerning the working of the process.

The "Rhenania" Chemical Works of Aachen exhibited at Vienna, in 1873, models of the kilns which were first constructed at Stolberg, on the principle of Wilhelm Helbig and of the author.* These kilns serve for burning finely powdered sulphur ores, and especially for iron-pyrites and zinc-blende. The peculiarity in the construction is that the ores are roasted upon strongly inclined planes, down which the pulverulent mass slides when a portion of ore is taken away from below.

The plate furnace described in 1870 is in extensive use for burning the smalls resulting from breaking up the ores, and is at present being set up in several manufactories. It is charged with a mixture of coarser and finer fragments, sand-ore, and meal-ore. The lumps are burnt in the ordinary manner close by the plate tower, and the hot gases escaping, sweep over the plates and burn the smalls. The ore passes over the plates in the form of a continuous stream, the thickness of which is determined by the interval between two plates. Green ore is added and burnt ore withdrawn without interrupting the process. The upper aperture is kept covered with a heap of ore, so that as it slides down no sulphurous acid can escape at the hopper. At the lower part of the furnace the burnt stratum of pyrites is removed by means of a roller, which revolves automatically every five minutes, and is driven by a small water wheel. Paul Seybel, of Liesing, near Vienna, works the kiln intermittently withdrawing about 200 kilos. of burnt ore every six hours by turning the roller. As smalls in very fine powder do not slide down well, Seybel's method is preferable for such ores. At Liesing, ores from Bösing, in Hungary, are burnt in plate kilns down to about 4 per cent, and Styrian ores down to about 7 or 8 per cent. The burnt lumps of the latter kind retain 5 to 6 per cent of sulphur, whilst lump ores from Bösing burn down to 2 per cent.

Burnt smalls from the "Sicilia" mine, near Siegen, retain 4 to 5 per cent of sulphur according to the size of the furnace and the quantity of ore passing through it. The burnt lumps which have been roasted along with smalls retain 5 per cent of sulphur, whilst clean lumps burn down to 2 per cent. There is therefore a decided improvement in roasting these kinds separately.

To be continued.)

* *Zeitschr d. Ver. Deutsch. Ingen.*, 1870, p. 705, and 1872, p. 505.
† Read before the Royal Society of N. S. W. September 6, 1876.

ON THE FORMATION OF MOSS GOLD AND SILVER.†

By ARCHIBALD LIVERSIDGE,
Professor of Geology and Mineralogy in the University of Sydney.

The origin and mode of occurrence of certain of the metals which are found in the free or native state, both in mineral veins and disseminated through various rocks, has for some time been a question of much interest to me: my attention, however, has hitherto been directed more particularly to the circumstances connected with the occurrence of native gold and of the minerals with which it is usually found associated; and it was while performing an experiment to ascertain, if possible, whether the gold which was known to be present in a certain specimen of mispickel existed in the crystallised state, or was merely disseminated through the mineral in amorphous particles, that I first obtained the peculiar form of gold which I now have the pleasure to exhibit to the Society.

I have called this remarkable, and to myself hitherto unknown, artificial form of the metal "moss gold," because in many respects it resembles the well-known "moss copper,"—hence it is convenient to use the above

term for it, although it should be stated that none of the specimens of gold presented anything like so *velvety* an appearance as that commonly exhibited by moss copper.

One of the two specimens before me was a rich piece of mispickel from the Uncle Tom Mine, near Orange, I believe, and the other a somewhat richer specimen from Paxton's, or the Rampant Lion Mine, Hawkins' Hill, obtained from a depth of 200 feet. Both contained some visible gold; the first only a few small specks, but the second was fairly rich in free gold, although the amount was not to be compared to that which it now shows. Mispickel, I may remark, is a compound of arsenic, sulphur, and iron, combined in the following proportions:—

Iron	=	34·4
Sulphur	=	19·6 (or $FeAs_2FeS_2$)
Arsenic	=	46·0
		100·0

The first specimen was roasted in a muffle, in order to expel the sulphur and arsenic, and my intention then was to dissolve out the oxide of iron and to examine the residual gold for crystals or any trace of crystalline structure which might be present, as I hoped by the above means to set the gold so completely free from the matrix that I could at once ascertain whether it existed in the mispickel in a crystallised form or only in irregular or amorphous lumps and particles.

On taking the specimen out of the muffle after the whole of the arsenic and sulphur had been driven off, I found that the surface was studded with small, irregular, more or less rounded excrescences of gold, having much the appearance and colour of small drops of sulphur. On closer examination, and especially with the aid of the microscope, the surfaces of these mushroom-like growths were seen to be covered with minute capillary wires and branching forms, which in some cases appeared to be made up of minute irregularly-formed crystals. This is more noticeable in the second specimen. Some of the cavities in the gold are seen to be lined with the most beautiful little spiculæ of gold, and some of the rounded bosses are composed solely of such spiculæ, interlaced into a ball-like form. Many of these capillary wires are curled into most symmetrical and beautiful spirals; one about ¼ to ½ inch in length, and of about $\frac{1}{100}$ inch in diameter, is coiled with the utmost regularity, the pitch of the screw being maintained uniform throughout its entire length.

In some cases the mushroom-like growths are seen to be supported on but a very slender stem, while others have apparently become recumbent from their weight, and have grown along the surface.

It is by no means an uncommon thing to find natural gold in the form of capillary threads, which are often interlaced and twisted into beautiful and fantastic shapes; also as thin flakes and scales, having a more or less fibrous surface; and at times in scales so exceedingly thin that they are not thicker than ordinary gold-leaf. Some of the gold from Oura, near Wagga Wagga, occurs in this manner. The best-known Australian locality for filiform gold is, perhaps, the Upper Cave River, Queensland.

I should mention, however, that I have never seen or heard of any native gold presenting exactly the same kind of appearance as the before-described artificially-formed specimens, but certainly the latter is at times somewhat similar.

Origin of the Moss Gold.

The general appearance of these peculiar cauliflower-like excrescences of gold would, at first sight, tend to give one the impression that they had been formed in somewhat the same way as the blebs and excrescences often observed on coke, which are so familiar to us in a fire made of so-called bituminous coal,—*i.e*, caking coal,—in which constantly we see portions of the coal fuse and swell up into fantastic blebs and bladders until the imprisoned gas breaks through the thin skin and inflames with a brilliant light. After the more combustible portions have been volatilised and consumed, a hard, clinkery, and more or less cauliflower-like excrescence is left.

But I do not think that we can account for the form of these cauliflower masses of gold in a similar way, for the mispickel shows no traces of having undergone fusion, neither does the gold; the crystals of mispickel, which by the operation of roasting have become converted into oxide of iron, still retain their original form, even down to the jagged points along the sharp splintery edges of fractured surfaces. Hence it cannot be urged that the gold had merely been left in the form assumed by the fused mispickel in the same way that a cauliflower mass or capillary thread of coke is left by the escaping gas from a piece of fused coal.

Neither can the gold have been merely squeezed out through pores in the matrix by mechanical pressure, in the same way that clay is forced through moulds in the manufacture of earthenware drainage-pipes, for the enclosing matrix of mispickel during the operation of roasting becomes comparatively soft and tender. Hence it could not well offer sufficient resistance to the expansion of the gold to act as a wire draw plate, even if we suppose that the gold existed in the form of small pockets of metal, and that there are the necessary minute apertures and perforations in the mispickel through which the expanding gold could make its escape.

And again, the forms exhibited by the gold show that it has not been in a fused condition, neither does it appear even to have been of a pasty consistency.

To ascertain whether this remarkable form of gold was furnished by artificial mixtures of the metal and mispickel, or was solely confined to those occurring in nature, a series of experiments was commenced, and the results obtained satisfactorily showed that the same phenomena were presented by certain of the artificial mixtures employed.

Experiment.—80 grms. of powdered mispickel were fused under a film of borax with 1 grm. of precipitated gold. The whole of the gold was apparently taken up by the mispickel, for no metallic particles or shot could be detected in the fused mass of regulus. The button of regulus was then roasted at a low red-heat in the muffle; it fused, but after the whole of the arsenic and sulphur had been driven off, the oxide of iron was found to be more or less covered with a brown, non-metallic-looking, cauliflower-shaped mass of gold. On scraping it with the point of a knife the unmistakable yellow metallic streak of gold was at once exhibited.

Moss Silver.

Next a series of experiments was made in order to ascertain whether any light would be thrown upon the subject by the behaviour of silver compounds under somewhat similar conditions.

The first experiment was the reduction of silver chloride, in a bulb tube, by the passage of a current of pure dry hydrogen, mentioned by Dr. Percy, F.R.S., in his great work on "Metallurgy," and by other writers.

The silver chloride was allowed to fuse, but the temperature was kept very much below the fusing-point of silver, so much so that the glass was not even softened.

The surface of the reduced metal was somewhat mammilated and cavernous, and it was found in certain places to be covered with minute capillary threads and spiculæ of silver; the cavities also were more or less filled with them.

Some silver sulphide was prepared in the humid way from silver nitrate. This was well washed, dried, and transferred to a French crucible, and then fused under a layer of borax in an ordinary melting-furnace.

The mass of sulphide, weighing about 2 ozs., was then cut in two by means of a large knife and hammer, and one of the two parts roasted in a muffle furnace. The

piece of silver sulphide was placed on a small scorifier, just inside the mouth of the muffle, where for some time the temperature did not exceed the melting-point of tin (*i.e.*, about 442° F.). Within a very few minutes (between 10 and 15 minutes) after the lump of silver sulphide had been placed in the muffle, beautiful little growths of metallic silver were seen to be dotted over its surface, and particularly near the upper edges; the lower portion of the mass, to a height of about ¼ inch, only presenting one or two points of silver at the right-hand end. This experiment was repeated several times with fresh pieces of the silver sulphide.

The projecting filaments had a most brilliant silver-white colour and lustre.

Their surfaces are strongly striated parallel to the length of the filament, and the larger ones are in most cases more or less curved or spirally convoluted. Towards the base the majority become much thicker, and in one direction they are usually much broader than in the other; hence they in this respect somewhat resemble blades of grass.

In certain instances the crystals could almost be seen to lengthen; a perceptible increase in length in more than one instance was observed within the space of between one and two minutes.

The crystals seem to increase in length and thickness far more rapidly during the first hour than afterwards, and their growth does not appear to be materially hastened by urging the temperature; that between the melting-points of tin and zinc (770° F.) appeared to be the most favourable. At a higher temperature the whole surface of the silver sulphide becomes covered equally with a coat of metallic silver.

The extrusion of the silver crystals cannot well be caused by pressure from without inward, for neither the silver nor the silver sulphide undergoes fusion or even softening; neither can the production of the filaments be due to the simple and ordinary process of reduction by the removal of the sulphur as sulphurous acid gas, otherwise the whole surface of the mass of heated and more or less roasted sulphide should be covered with a coat of reduced metallic silver, just as when the sulphide is reduced in a current of hydrogen gas. But such is not the case; the extruded wires and filaments appear to be rooted in the sulphide, as if they pushed their way out from within, and they usually project out at nearly right angles to the surface of the apparently unchanged dark lead-coloured silver sulphide, just as Dr. Percy describes the formation of silver filaments, from the same compound under the reducing agency of a current of hydrogen gas.

It may be that their formation may have been determined by the presence of nuclei of some sort, just as in the case of various saline solutions.

On even the most searching examination I cannot detect any difference between the filamentous silver thus artificially formed and specimens of similar native silver.

Since making my experiments, I find that De la Beche says, in his "Geological Observer," p. 768:—

"Artificial sulphuret of silver was found to be readily decomposed by steam, and more easily so at a moderate heat. At a temperature under the melting-point of zinc this was soon effected, and the silver effloresced in such forms as to induce M. Gustav Bischoff to regard the moss-like and filamentous occurrence of native silver in veins as very probably the result of the decomposition of sulphurets."

Moss Copper.

It is a well-known fact that metallic copper occurs diffused through certain kinds of copper regulus, in the form of minute angular particles, which do not show the least trace of having undergone fusion: all the edges of these particles are sharp and not in the least rounded, and where cavities occur the metallic copper may be seen protruding into them in the form of minute points and hair-like threads or filaments."

Dr. Percy, in speaking of *moss copper*, says*;—"In copper works this term is commonly used to designate those accumulations of filamentous or moss-like copper which are formed in cavities in pigs of certain kinds of regulus. Mr. Edward informs me that, in making copper from Cornish ores, moss copper seldom appears, but more of it is produced when these ores are melted in admixture with a little Irish ore (copper pyrites mixed with *much iron pyrites*): it occurs most abundantly when foreign ores are much used. It is chiefly observed, and in the finest state, in *pimple metal*, when all the cavities are filled with it, and it is found protruding from the bottom of the pigs into the sand underneath; sometimes a little of it, strong and wiry to the touch, appears on the upper surface of the pigs. According to Mr. Edward, it may be seen in the little prills or shots of *metal* in the ore slag; and the surface of the pigs of metal from the *calcined metal* furnaces are covered with a coating of it, generally of a dark colour, and as thick as the nap or pile on velvet.

"In specimens in my collection the filaments of copper vary in size from the finest thread to fibres 3-16ths of an inch in diameter, and from one of three specimens obtained from a *fine-metal* furnace-bottom I have taken separate filaments perfectly continuous, and exceeding 5 inches in length.

"Under the microscope the filaments present numerous minute parallel and longitudinal lines or grooves, as though they consisted of bundles of extremely delicate fibres. . . .

"The mode in which these fibres are produced is an interesting subject of inquiry. Each fibre seems to have been pushed, as it were, through a draw-plate, and at a temperature when the metal was soft, but certainly not exceeding that of well-melted copper, for otherwise the fibres immediately after their protrusion would have been re-melted into globules." Then he goes on to mention that "filaments of silver, which, examined under the microscope, appear to possess *identically the same structure* as those of moss copper, may be formed by heating finely-divided sulphide of silver in a current of hydrogen at a temperature sufficient to agglutinate the sulphide, but below the actual melting-point of silver. This beautiful experiment may be made in a glass tube, through which a current of the gas is passed. Long delicate fibres of silver may be seen protruding from minute rounded masses of the sulphide; and as they are produced while these masses are in a soft state, and lying free in the tube, the idea that they result from the application of external mechanical pressure, in a similar manner to maccaroni, can hardly be entertained.

"There seems to be a force in operation at the base of each filament, which causes the particles of silver at the moment of liberation successively to arrange themselves in one continuous fibre or series of fibres; or, in other words, each filament grows, as it were, from a root imbedded in sulphide of silver."

Experiment.—I placed some lumps of native copper disulphide (*Redruthite*) in a hard-glass bulb tube, heated and passed current of hydrogen gas. After the experiment the whole surface of the mineral was found to be thickly covered with a nap of acicular filaments of copper. No traces of fusion were exhibited.

Dr. Percy also shows by a series of experiments that metallic copper is separated in a similar way by simply fusing some copper disulphide (Cu_2S) in a crucible. And he further states that there is at present no certain knowledge of the cause which brings this about.

The foregoing results obtained by different eminent scientific observers, together with those yielded by my own experiments, afford, I think, some very interesting information, much important matter for reflection, and a large field for future experiment.

The conditions under which the formation of crystals have been observed may be briefly stated to be comprised by the following divisions; *i.e.*, crystallisation takes place under the following conditions.—

* Percy's "Metallurgy," vol. i., p. 359.

Methods by which Crystallisation may be produced.

1. By condensation from a state of vapour.
2. From solution.
3. From a state of fusion.
4. By electrolysis.
5. By "spontaneous" change.
6. By thermo-reduction.

1. *Condensation* of a substance from a state of vapour,—*e.g.*, iodine, arsenic, water-vapour yielding snow and hoar-frost.

2. *Crystallisation from Solution.*—As when crystals of a salt are obtained by the evaporation of its solvent, and as when a solution of sulphur in carbon disulphide is allowed to evaporate spontaneously, beautiful crystals of sulphur are left.

3. *On Solidification from a State of Fusion.*—This is commonly seen when metals such as bismuth, antimony, and others are allowed to solidify slowly. Beautifully crystallised examples of such metals and of sulphur may be readily obtained in the following way:—Melt a considerable quantity of the substance in a crucible or ladle, and when a thin coat has formed over the surface by cooling, pierce the crust, and pour out the still fluid contents as quickly as possible. A large part of the metal or sulphur, as the case may be, will be left lining the inside of the crucible in the form of most beautiful groups of crystals with sharply-defined edges and angles, and not as the rounded, imperfect, semi-fused-looking bodies that we might naturally expect when we consider the density and viscosity of the fluid in which they were formed and by which they were bathed.

4. *Crystallisation by Electrolysis.*—When solutions of the salts of the heavier metals are submitted to the action of electric currents they undergo decomposition, and the metal which is deposited at the negative pole is usually more or less crystallised. A current of low intensity, *cæteris paribus*, seems to favour the formation of well-developed crystals. The reduction of a metallic solution by a more electro-positive element may probably be classed under this head, as stannic chloride by zinc, or silver nitrate by lead, and so on.

5. *Spontaneous Crystallisation*, as it is usually termed, —*e.g.*, the gradual passage of amorphous plastic sulphur into the crystalline state, also the similar change undergone by barley-sugar. Many well-known chemical precipitates apparently undergo spontaneously a similar change. Again, the gradual conversion of tough fibrous wrought-iron into hard brittle iron with short grain, by repeated concussion and vibration, seems to be a variety of crystallisation; certainly a great molecular change has taken place—but this matter requires further investigation. Then we have the passage of blocks of tin, which had been exposed to intense cold, from the malleable and non-crystalline to a fibro-crystalline and brittle state; in fact, so brittle does the tin become that it more or less completely falls to powder.

The devitrification of glass may also be here mentioned.

6. *Crystallisation by Thermo-reduction.*—I think that we may safely regard the forms exhibited by the artificially produced moss metals as varieties of crystalline forms, and with as much reason as the mineralogist assigns a place for the similar natural forms amongst crystals; the arborescent and other group forms assumed by native metals can be traced from normal and primary forms, such as of the octohedron and rhombic dodecahedron through various degrees of elongation and attenuation until we arrive at the filiform and capillary threads, a number of which aggregated together give the velvet or plush-like mass of moss copper or other metal. Moreover, some portions of the gold reduced from the mispickel showed branching and arborescent groups which had all the appearance of elongated dodecahedra placed end to end, in no way differing from natural specimens except in minuteness and perhaps greater brilliancy of lustre.

But these crystals have been produced by a process differing considerably from the methods enumerated in the first five divisions; hence the necessity for forming the sixth and last group.

The artificially prepared moss metals are produced by a process of reduction, aided neither by vaporisation, solution, fusion, nor electrolysis, neither are they produced "spontaneously," but they are prepared by the aid of a heated reagent. Hence I have for convenience ventured to form a special class, *i.e., crystallisation by thermo-reduction.*

This matter is, of course, very closely connected with the ordinary metallurgical processes of reduction, but in such manufacturing operations no effort is made to obtain the metal in the crystallised state; on the contrary, it is the practice to favour the conversion of the metal into the liquid state as speedily as possible.

Although, perhaps, there may be no true analogy between the two cases, still it would be very interesting to calculate the amount of force requisite to produce the crystals, supposing that they had been mechanically pulled out like wires through a draw-plate, or had been squeezed out through moulds similar to lead tubing.

I hope at some future date to be in a position to supplement the foregoing preliminary notes upon a question which is of great interest and importance in the chemical geology of mineral veins and deposits, when the series of experiments at present in hand are somewhat nearer completion.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, December 21st, 1876.

The PRESIDENT in the Chair.

THE following notes, descriptive of some of the apparatus exhibited, were read:—

"*Fletcher's Improved Aspirator and Blower*," by J. W. SWAN. This is a modification of the old Sprengel pump, from which it differs in some most important points.

It will give an average duty as a blower of at least double.

It will work with a fall of water so small as to be totally useless for the old form.

The water inlet is arranged so as to throw the water across the descending tube in compact masses, which act as pistons from the moment they enter the tube, and if the air and water are examined as they descend they will be found quite separate and distinct from each other. In the old Sprengel pump, when examined in the same way, the water will be found to form a thick lining to the tube, with a free column of air in the centre, and in the whole length of the tube a large quantity of water can be seen running down the sides, doing absolutely no work.

When a descending tube with a fall of 7 inches is used, it will bear immersion until the water overflow is only one inch below the inlet, and will still deliver air 6 inches below the overflow level. No greater test of the efficiency of this part of the apparatus can be conceived than the fact that a fall of water of three-fourths of an inch will pump air steadily into a tube of five-sixteenths inch bore, or nearly half the diameter of the total fall. Whatever the speed or fall used, the clear definition between the water pistons and the air is equally distinct; and so far as I have tested the arrangement the efficiency as a blower or aspirator is in direct proportion to the difference in level between the inlet and outlet pipes. The air and water at the bottom of the descending tube are delivered against the side of the air chamber, down which the water runs quickly, thus preventing to a great extent the presence of water vapour in the air. As an additional safeguard the air chamber is made very narrow and tall, and at the air outlet near the top is also placed

a spiral water trap. I find that 2 cubic feet of water per hour, with a fall of 2 feet, will supply an ordinary blowpipe with air at a pressure of 12 inches of water. The same quantity of water falling 4 feet will supply two blowpipes, or will supply one with air at double the pressure.

Its efficiency as an aspirator is in proportion, as it perfectly utilises the total height of fall of the water.

The principal points in which this form has an advantage are, its far greater efficiency with a limited supply of water and low fall and the unusual freedom of the air from suspended water and water vapour. It is, in fact, an efficient (cylinder and piston) blower and aspirator working to within a very slight margin of the total theoretical calculated power.

"*Electrical Notes*," by A. Hellisen.

1.—If the primary wire of one Ruhmkorff coil is interposed between the break and the condenser of another (in action) the secondary wire of the first-named coil will show electricity of very high tension which is not subject to the same rules as that of ordinary induced currents. The coil first named may be replaced by two short insulated wires running parallel in zigzag, or being stretched, and still the electricity of the wire that is unconnected will penetrate a space of air when the ends of this wire are approached. Coiling round a core makes the spark brighter but not longer, and the core scarcely shows any magnetism.

2.—Lead may be substituted for carbon in chromic acid cells, and very conveniently combined with it to form constant single fluid cells.

3.—Lead may be electro-plated direct by using a strong solution of silver cyanide and a strong current, and if platinised afterwards furnishes first-rate negative plates for sulphuric acid cells on Smee's principle, that have *no drawbacks*, and will last unchanged any length of time. Lead is recommended for voltaic purposes by being very *manageable*, cheap, and cleanly in contact with sulphuric acid, which cannot be said of graphite, silver, or copper, respectively.

4.—When a piece of copper, bent so as to dip with one end in the upper part of an acid, or a solution of copper, is kept hot by a lamp, while the lower part of the fluid, in which another piece of copper is immersed, is kept cool, a galvanometer uniting these two pieces of copper will indicate a constant current going from the heated plates to the cold (this latter accordingly acting the part of zinc). Lead, graphite, &c., in acids, show the same phenomenon, as far as I have yet tried.

5.—If thin wires, representing the poles of a pile of high tension (I used thirty minute chromic acid cells with lead), are brought one after another in a soot-producing flame (say of a paraffin candle) the wire first in the flame will only cover itself with a thin smooth coating till the other wire is also brought into the flame. Then a very original vegetation will sprout up, tending upwards on both wires, which begins first at the negative pole forming a whole copse of pyramidical shrubs, whereas the positive pole will only a little later emit single long sprouts like cypresses. These agglomerations of soot, even if half an inch long, adhere to the wires afterwards, and when brought in proximity the branches bend to unite and interchange a spark. This very curious phenomenon magnified with a magic lantern would form a very striking public lecture experiment, and, as I never heard of it as such, I conclude it has escaped notice.

"*On Galvanic Cells*," by J. W. Swan. I take the opportunity of publishing, through the medium of the Society, a little fact which I have found very useful in the management of galvanic cells required to be maintained ready for action during a long period. It is the use of a thin stratum of oil on the surface of the liquid with which the cell is charged. It is particularly applicable in the case of the simple carbon and zinc element, charged with solution of chloride of ammonium or chloride of sodium, and much used for electric bells and clocks. The oil covering also tends to conserve the effectiveness of the Leclanché cell. Loss of liquid by evaporation, and by crystallisation on the side and over the edge of the cell, are prevented, insulation is improved, and consequently the energy of the cell is less wasted.

"*Percolator*," by B. S. Proctor. A slight modification of the customary form of percolator, to adapt it to the exhaustion of small quantities of opium, &c., in analysis. It consists of the usual cylindrical tube and receiver, with the addition of a cylinder of tin plate or other suitable material, closed at both ends, fitting loosely within the percolation tube; the object being to get a slightly increased hydrostatic pressure with a small quantity of solvent. The substance to be exhausted, diffused through a small quantity of the solvent, is poured into the glass tube, and then the tin tube being brought down till it touches the top of the liquid, its position is fixed, and more of the solvent is added. As this addition occupies the narrow space between the two cylinders, a head of 6 or 8 inches is obtained with a small quantity of liquid. This arrangement has also the advantage of permitting fresh additions of solvent without their mixing with that portion which by contact with the marc has become charged with extractive.

"*Luting and Washers for Ether, Sulphide of Carbon, or other Volatile Liquids*," by B. S. Proctor.

No. I.

Clay	30
Water	3
Glycerin	8

No. II.

Clay	30
Gum Tragacanth	1
Water	3
Glycerin	8

No. III.

Clay	5
Gelatine	2
Water	2
Glycerin	6

No. IV.

Felt.	
Gelatine	2
Water	2
Glycerin	6

Where a clay luting is required to retain its impervious character for a length of time, the addition of glycerin by preventing its drying imparts that character; but if glycerin and clay alone are used the mass becomes softer by exposure, from the absorption of moisture. In the luting No. I., the glycerin and water are present in such proportion as to give it little tendency to become either harder or softer.

A joint made with No. I., if not kept rigid, ceases to be tight; but No. II. will allow of a little motion, especially if rather more moist. No. III. gives more flexibility, but requires to be applied warm, and of course will not resist heat—even a gentle heat—in use.

The presence of the clay makes the gelatine less fluid while warm, and consequently more convenient in application. Fluidity is still more completely got rid of in the following:—No. IV. takes the form of a washer, and may be applied warm to delicate apparatus, or cold where mechanical pressure can be used freely. It appears to be quite impervious to the vapour of ether. The felt is simply soaked on the melted gelatine and glycerin, and the superfluous quantity pressed or drained out. Corks and bungs may be saturated with the same compound by being boiled in it for half an hour, and kept submerged till the temperature has fallen considerably. If then drained, and the superfluous jelly rubbed off the outside, they are in a condition suitable for stopping vessels of ether, sulphide of carbon, or benzine.

Glass stoppers may be lubricated with this glycerin

jelly in some cases where oily lubricants would be objectionable.

Probably casks might advantageously be lined with a similar compound before being used for petroleum or coal oils.

NOTICES OF BOOKS.

Report to the Secretary of State for the Home Department on the Subject of the Testing of Petroleum. By Dr. F. A. ABEL, F.R.S., Chemist to the War Department.

THE opinion has become very general that the so-called open "flashing-test," as required by the existing Petroleum Act, is unsatisfactory and even fallacious. The chief objection is that it is liable to "manipulation," accidental or designed, *i.e.*, "in consequence of certain very readily variable elements in the details of the test (added to the interfering action of even slight currents of air) the flashing-point of one and the same sample may be made to differ many degrees in the hands of different operators, or of one and the same operator at different times. On this point Messrs. T. W. Keates, Dugald Campbell, the late Dr. Letheby, Drs. Attfield, and B. H. Paul, Dr. Redwood, Secretary of the Petroleum Association, the Secretary of the Scottish Mineral Oil Association, and the local authorit es under the Act at Bristol and Liverpool are substantially agreed. It is pointed out that "great difficulties have arisen in connection with the present regulations respecting the testing of petroleum oils, consequent upon the legalised acceptance of oils as safe or their condemnation as dangerous upon a difference of even *one* degree in their flashing-points as determined by a test which may give differences of *several* degrees *with one and the same oil* in the hands of different operators." Prof. Abel has therefore elaborated a so-called "close-test" to be performed with a simple piece of apparatus, which is here described at length and figured, and which has been pronounced satisfactory by Messrs. Keates and Redwood, and also by the Secretary of the Scottish Mineral Oil Association, Mr. B. Calderwood. Prof. Abel's instructions for the application of the test are as follows:—The apparatus should be placed for use in a position where it is not exposed to currents of air.

The heating vessel or water-bath is filled by pouring water into its funnel until it begins to flow out at the spout of the vessel. The temperature of the water at the commencement of the test is to be 130° F., and this is attained in the first instance either by mixing hot and cold water in the bath, or in a vessel from which the bath is filled until the thermometer provided for testing the temperature of the water gives the proper indication; or by heating the water with the spirit-lamp (attached to the stand of the apparatus) until the required temperature is indicated. When a test is completed the water-bath is again raised to 130° by placing the lamp underneath, and the result is readily obtained whilst the petroleum cup is being emptied, cooled, and re-filled with a fresh sample to be tested. The lamp is then turned on its swivel from under the apparatus, and the next test is proceeded with. The test lamp is prepared for use by fitting it with a piece of flat plaited candle wick (*e.g.*, Field's night-light candle wick), and filling it with colza or rape oil up to the lower edge of the opening of the spout or wick-tube. The lamp is trimmed so that when lighted it gives a flame of about 0·15 inch in diameter, and this size is easily maintained by manipulation from time to time with a small wire trimmer. A test-flame arrangement for gas has been devised and may be substituted for the lamp. The bath having been raised to the proper temperature the oil to be tested is introduced into the petroleum cup, being poured in slowly until the level of the liquid just reaches the point of the gauge fixed in the cup. In warm weather the temperature of the room in which the samples to be tested have been kept should be observed in the first instance, and if it exceeds 65° the samples to be tested should be cooled down to about 60° by immersing the bottles containing them into cold water. The lid of the cup, with the slide closed is then put on and the cup placed in the bath or heating vessel. The thermometer in the lid of the cup has been adjusted so as to have its bulb just immersed in the liquid, and its position is not under any circumstances to be altered. When the cup has been placed in the proper position the scale of the thermometer faces the operator. The test-lamp is then placed in position upon the lid of the cup, the lead-line or pendulum which has been fixed in a convenient position in front of the operator, is set in motion, and the rise of the thermometer in the petroleum cup is watched. When the temperature has reached about 66° the operation of testing is to be commenced, the test-flame being applied once for every rise of one degree, in the following manner:—The slide is slowly drawn open while the pendulum performs three oscillations, and is closed during the fourth oscillation.

After careful consideration we have every reason to believe that Professor Abel's method will lead to accurate results—no small boon to the general public as well as to all connected with the petroleum trade.

On Boiler Incrustation and Corrosion. (Read before Section G, British Association, Glasgow Meeting, September, 1876.) By F. J. ROWAN. London: E. and F. N. Spon.

AMONG the various duties which water has now to fulfil, not the least important certainly is to serve for the generation of steam, and its varying fitness for this purpose often occasions no little perplexity. For incrustations a number of remedies have been proposed, some of which, like a quack life-pill, are warranted to answer in all conceivable cases, whilst in reality they are not useful in any. In most cases the author considers soda-ash as the best preventive. Under its influence the sulphate of lime is decomposed, and the carbonate obtained both from this source and from the bicarbonate of lime is deposited as loose powder incapable of forming incrustations. With intelligent supervision there is no fear of any unpleasant results. Where the impurity consists mainly of sulphate of lime the soda-ash may be added to an external feed-tank or cistern instead of into the boiler. Lime and zinc have been successfully used against the bicarbonate of lime, but in case of the sulphate they are useless. Starchy and gelatinous matters, according to the experiments of M. Bidard, rather promote than prevent incrustation. Sodic oxalate and tannate also serve to increase the quantity of the deposit. Sal-ammoniac and hydrochloric acid are very limited in their preventive power, and as might have been foreseen are liable to inflict serious damage on the boiler and its connections. Raw pyroligneous acid has been proposed in case of carbonates existing alone, and for sulphate petroleum has been used with success. But in waters impregnated with carbonate of lime it is not recommended. Soap makes the boilers filthy, sometimes forms a corrosive crust and promotes priming. A process is also in use which turns on the power of chloride of barium to decompose all sulphates present and liberate the carbonic acid in the water. The author, however, holds that for land-boilers the best system is to work in connection with surface condensers, and so supply them with really pure water. This is the more important "in view of the extended use of sectional or water-tube boilers."

Corrosion is apparently a more puzzling phenomenon than incrustation, since it takes places with waters of a high degree of purity, such as the water from Loch Katrine supplied to the City of Glasgow. Carbonic acid and oxygen in solution cause iron to rust away, as was first proved by the late Dr. Crace Calvert, and has been confirmed by more recent observers. The author's con-

cluding remarks are not without significance:—"Apart from such a plan there seems no hope of escaping corrosion and advancing at the same time in engineering practice until it is possible to have copper boilers. And yet, even then, as the recent experiments of Carnelley on the action of water and of various saline solutions on copper (*Chem. Soc. Journ.*, No. clxiii., p. 1) seem to show, we should still have to combat the same difficulties."

We consider that this pamphlet is well worthy the careful attention of chemists, to whom it points out a vast and important field for useful research.

A Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas. London: W. B. King.

We have here before us the first number of a work which promises to be exceedingly valuable. Like many other of the chemical arts the manufacture of gas has undergone of late certain changes which render former treatises on the subject practically obsolete. Hence a new work fully on a level with the practical knowledge of the day is evidently needed, and will doubtless be appreciated. The treatise opens with a sketch of the history of coal-gas—a subject on which misconceptions, if not misrepresentations, prevail to a serious extent. Next will follow a full account of the geology, lithology, and chemistry of coal; the raw material, and a description of the properties, manufacture, and purification of the gas produced. Then will come a notice of the manufacture of illuminating gas from other materials, and of methods of lighting proposed to supersede gas altogether. Lastly, the disposal and utilisation of the residual products are to be taken into consideration.

The historical section opens with a few remarks on the dawn of our knowledge of the gaseous bodies—a subject which, if touched upon at all, might have been handled with more accuracy and comprehensiveness. The earliest notice of a gaseous hydrocarbon occurs, we are told, in a paper communicated to the *Philosophical Transactions* in 1667, by Thomas Shirley, describing his observations made in 1659 upon the so-called "Burning Well," near Wigan. In this paper experiments are described proving that the combustion was due, not, as was commonly believed to the water itself, but merely to a gas escaping through the water. The next step was taken by Dr. John Clayton, Dean of Kildare. His paper is inserted in the *Philosophical Transactions* for 1739, and is without a date. But the original manuscript in the British Museum is addressed to Robert Boyle, who died as early as 1691. Hence Clayton's observations must have been made not long after those of Shirley. Visiting Wigan and examining the well, which had become much feebler, he caused the water to be dammed out, and digging to the depth of half a yard found a bed of shelly coal, the air escaping from which was found to be combustible. He did not, however, stop here. He submitted coal to destructive distillation and obtained a combustible gas; he describes, in short, in his paper "the means of storing this gas, the pressure necessary to expel it to be inflamed, the facility of lighting and extinguishing, and the possibility of its being kept for a considerable time without losing its inflammability." He advanced, in fact, our knowledge of coal-gas to such a point that all was ready for an applier to step in, manufacture it on a large scale, and turn it to account. Even, therefore, had Lebon anticipated Murdoch, the discovery of coal-gas would still belong to this country,

The researches of Priestley, Black, and Cavendish are next described, and the authors then pass on to a notice of Murdoch, the first practical applier of coal-gas. Whilst living at Redruth, in 1792, he engaged in experiments on the production of coal-gas, and on the cost of the light thus obtainable in comparison with the cost of illumination by lamps and candles. In 1797, he "lighted his premises at Old Cumnock, in Ayrshire, with coal-gas, exhibiting the light to numerous spectators," and in 1798 he erected an apparatus at the Soho Foundry, Birmingham, lighting up one of the buildings for several successive nights, and trying various methods of purifying the gas.

We must now turn to Le Bon or Lebon, whom certain French and American authorities consider as the inventor. His patent was not taken out till 1799, and we may observe that inventors about to take out a patent are as a rule very cautious not to publish their ideas previously. There was, moreover, exceedingly little communication at that time between France and England. To assume, therefore, without the shadow of evidence, that Murdoch derived any assistance from Lebon is utterly unjustifiable. Lebon's specification, further, which is quoted in the work before us, proves that his apparatus is "of the most impracticable kind," and that "he had no definite idea or system with reference to the application of gas, either for lighting or heating." He also states that "either wood, coal, oil roots, grease, or other combustible matters can be employed, the results being always the same." These words alone are sufficient to show that his knowledge of gas was crude in the extreme. Even in his certificate of additions, obtained in 1801, it still appears that his main object was to obtain motive power by the explosion of inflammable gas when mixed with atmospheric air.

It is therefore evident that the honour of the practical application of coal-gas as a source of light belongs to Scotland.

One question here suggests itself to our mind: Is it because Murdoch was by profession an engineer that the manufacture of gas, which, abstracting from the subsidiary process of its distribution, is essentially a chemical art, has fallen completely into the hands of a body of engineers?

CORRESPONDENCE.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

Sir,—Some time ago there appeared in a Portuguese paper an advertisement very similar to the one referred to by Dr. Austen; it was rather more explicit, however, and stated that the diplomas were to come from the University of Jersey.

"Medicus" may obtain his from some place having a more material existence, but if so, he does not obtain them in Jersey.—I am, &c.,

Thos. M. Morgan,
Professor of Chemistry, Victoria College, Jersey.

February 6, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade, unless otherwise expressed.

Justus Liebig's Annalen der Chemie,
Band 184, Heft 2.

Contributions to the Theory of Luminous Flames.—Dr. Karl Heumann.—In this interesting essay the author demonstrates the existence of solid carbon in the luminous flames of the hydrocarbons. Chlorine imparts a considerable luminous power to the feebly luminous or non-luminous flames of hydrocarbons. As chlorine at a red heat separates solid carbon in the form of soot from the hydrocarbons, the luminosity thus produced must be due to solid particles of carbon. A slender rod held in the luminous flame is coated with soot almost exclusively on the lower side exposed to the stream of gas, proving

that the soot impinges against the rod in a solid state. If the luminous flame surrounding the rod on all sides contained the soot as a vapour, the smoking would be a condensation—and effect of cooling—and would take place on all sides of the rod, which is not the case. Deposition of soot is observed on strongly ignited surfaces, which would not be possible if it were the condensation of a vapour, and therefore due to cooling. Just as the separate particles of carbon in an ascending column of soot only become visible to us when the exceedingly minute and numerous corpuscles are agglomerated into somewhat larger masses in consequence of impact against quiescent strata of air or solid bodies, and have lost a part of their speed, in like manner the particles of carbon in luminous flames can be rendered visible if the flame is caused to come in collision in a suitable manner with another flame or with an ignited surface. The separated particles of carbon come in mutual collision, and unite to larger and less numerous masses, so that the luminous mantle of the flame appears scattered over with innumerable luminous points. The smoke of such a flame is very coarsely granular. The luminous stratum of a flame is not transparent in a high degree, and is the more opaque the greater its thickness and the more particles of carbon it contains. The transparence of a luminous flame is not greater than that of a smoke column of equal thickness arising from the flame of burning oil of turpentine, and filled, as is well known, with solid particles of carbon. The flame of hydrogen charged with chloro-chromic acid, and indubitably containing solid chromic oxide, is quite as transparent as the flames of hydrocarbons. Flames which notoriously owe their luminous power to the presence of finely-divided solid matters cast a characteristic shadow in the sunshine. Luminous flames consisting merely of incandescent gases and vapours give no shadow, but merely lighter and darker bands or clouds, due to the refraction of light. Luminous hydrocarbon flames throw in the sunshine a well-defined and intense shadow, consequently they contain a solid in a state of minute division. This solid can be nothing but carbon, as follows from the absence of other solids capable of bearing ignition.

Band 184, Heft 3.

Action of Phosphoric Pentachloride upon Phenyl- and Para-Toluyl-Oxamethan.—H. Klinger.—PCl_5 acts upon amides, according to the old view of Gerhardt, the experimental confirmation of which was hitherto wanting—$CONHR + PCl_5 = CCl_2NHR + POCl_3$. This confirmation was also furnished by Wallach, who prepared the amide-chloride of oxamethan. If gently heated, or treated with gaseous ammonia, amide-chloride loses 1 molecule of HCl, and becomes an imide-chloride. With water, aqueous alkalies, and aniline, amide- and imide-chlorides behave qualitatively perfectly alike. The introduction of the phenyl group into the amidic residue of oxamethan prevents the formation of basic bodies. The action of the phenyl-residue is not annulled when one of its hydrogen atoms is replaced by the radical CH_3. In the author's experiments the groups CH_3 and NH occupied the para position.

A Contribution to the Knowledge of the Thiamides of the Monobasic Organic Acids.—Dr. Aug. Bernthsen.—This paper comprises an examination of phenyl-aceto-thiamide, its transformations, its behaviour with nascent hydrogen, the reduction of benzyl-cyanide by nascent hydrogen, the action of iodine upon phenyl-aceto-thiamide; the behaviour of phenyl-aceto-thiamide and other thiamides with ammonia and amine bases; and an account of the constitution of the thiamides. There is also an appendix treating of phenyl-acetamide.

New Methods of Preparation of the Amidins of Monobasic Organic Acids.—Dr. Aug. Bernthsen.—A lengthy paper, not adapted for useful abstraction.

Determination of Nitrogen by Will and Varrentrapp's Method.—C. Makris.—The sources of inaccuracy are the possible dissociation of ammonia at high temperatures, and the combustion of a part of the ammonia when air is drawn through the apparatus at the end of the operation. These causes of error, according to the author, may be avoided by not allowing the temperature to rise above dull redness; by taking care that the ammoniacal gas is sufficiently diluted as it passes over the ignited soda-lime; and by drawing through the combustion-tube at the end of the operation, not atmospheric air, but some indifferent gas. He takes a combustion-tube 60 centimetres in length, not drawn out to a point, but rounded off at the end, and introduces, first, 0·3 grm. of sugar free from nitrogen, and mixes it by shaking with about twenty times its weight of soda-lime in powder. Upon this follows a stratum of granulated soda-lime 12 centimetres in length, then 3 centimetres of powdered soda-lime; then a mixture of the substance under analysis (say 0·2 grm.) with 0·3 grm. sugar and powdered soda-lime; the tube is then filled in the ordinary manner with granulated soda-lime, followed up with the asbestos plug, and cork as usual. At first the anterior layer of pure soda-lime is heated to dull redness; then the stratum of soda-lime between the sample and the mixture of sugar and soda-lime at the back of the tube; then finally the sample, so that a slow but continuous current of gas is kept up. When the escape ceases, the mixture of soda-lime and sugar at the back of the tube is heated so as to sweep the residual ammonia out of the tube.

Gazzetta Chimica Italiana.
Anno vi., 1876, Fascicolo ix.

Function of Chlorophyll in the Vine.—Giovanni Briosi.—A preliminary notice.

Nitro-Derivatives of Salicylic Aldehyd.—G. Mazzara.—The author has resumed the study of this compound, first examined by Lœwig in 1836, and finds that the action of nitric acid upon salicylic aldehyd gives rise to two isomeric mono-nitro-derivatives of a strongly marked acid character.

Reciprocal Action of Iodide of Potassium and of Sulphate of Lead.—Prof. G. Campani.—Iodide of potassium in solution forms with sulphate of lead iodide of lead and sulphate of potassa. With phosphate of lead the same transformation occurs.

Detection of Manganese in Ashes in the State of Phosphate.—Prof. G. Campani.—Manganese may occur in ashes in the state of oxide or of a salt. When there are sufficient phosphates in the ash it is treated with an excess of hot aqua regia, the liquid filtered, and evaporated to dryness in a porcelain capsule on the water-bath. If the ash contains manganese the residue presents an amethyst or violet colour, more or less intense, according to the quantity of the phosphate of manganese produced. As all ashes do not contain phosphates, the author finds it useful to treat with a mixture of 15 c.c. of syrupy phosphoric acid and 85 c.c. of nitric acid.

Detection of Picric Acid in Beer.—Dr. Dioscoride Vitale.—The author agitates 10 c.c. of the suspected beer in a test-tube with half its volume of pure amylic alcohol. If the mixture is left to settle, the amylic stratum separates entirely, and is drawn off with a pipette, evaporated to dryness at a convenient temperature in a porcelain capsule, and the residue is finally taken up in a little distilled water with the aid of heat. The aqueous solution is divided into portions, and submitted to the following reagents. One portion is treated with a solution of the ammonio-sulphate of copper, which in dilute solutions of picric acid instantly produces a turbidity, due to the formation of very minute crystals of the ammonio-picrate of copper of a greenish colour. Another portion may be tested with a concentrated solution of cyanide of potassium, which produces a blood-red colour, more or less intense, according to the quantity of picric acid present, in conse-

quence of the formation of iso-purpuric acid. A third portion may be submitted to the action of sulphide of ammonium, rendered still more alkaline by the addition of a few drops of ammonia. Here, also, a blood-red colour is produced, which becomes more intense on the application of heat, and is due to the formation of picramic acid.

Anno vi., 1876, Fascicolo x.

Chemistry at the Fifth Reunion of the Russian Men of Science.—The substance of the chemical papers read at this meeting is noticed elsewhere.

Researches on Picrotoxin.—E. Paterno and A. Ogliaioro.—The analysis executed by the authors gave—

Carbon	59·38
Hydrogen	5·44

which agrees with the formula $C_9H_{10}O_4$ better than with $C_{12}H_{14}O_5$.

Researches on Cumophenol.—E. Paterno and E. Spica.—A description of cumophenol, its methylic ether, and its acetylic derivative.

Assay of Zinc Ores.—The electrolytic method first applied by Luckow to the assay of copper, cobalt, and nickel ores has been successfully applied to ores of zinc in the laboratory of Antonino Mascazzini.

Declaration.—T. Brugnatelli.—The author gives notice that he does not intend to accept any responsibility for the views of Prof. Lombroso on the alkaloid present in decaying maize, and leaves to him the entire merit.

Researches on Essence of Turpentine.—G. Papasogli.—Not suitable for condensation.

Specific Heat of Carbon, Boron, and Silicon.—F. Weber.—Already noticed.

Bulletin de la Societe Chimique de Paris,
No. 11, December 5, 1876.

Synthesis of Allantoin.—M. E. Grimaux.—Allantoin may be obtained by heating 1 part of glyoxylic acid and 2 parts of urea for eight to ten hours to 100°. The mass is taken up with four times its weight of boiling alcohol, and the residue, insoluble in alcohol, is dissolved in twelve to fifteen times its weight of boiling water. The crystals formed are purified by re-dissolution in water.

Process for the Detection of Magenta in Wine.—M. Fordos.—Already noticed.

Determination of the Dry Residue of Wine.—M. L. Magnier de la Source.—The author operates on 1 grm. of the sample, which he evaporates in a dry vacuum, and weighs after the lapse of four days in summer and five or six in winter.

Disengagement of Hydrogen during the Action of Zinc upon Copper Sulphate.—M. L. Meyer.—Leykauf, who observed this phenomenon in 1840, thought it was attended with the production of cuprous oxide. The author finds, however, that there is a formation, not of cuprous oxide, but of basic sulphate of zinc.

Decomposition of Solutions of Potassic Alum at 100°.—M. A. Naumann.—If aqueous solution of alum is raised to 100° there is gradually formed a white precipitate, which, when washed with water, forms an amorphous powder mixed with brilliant laminæ, sparing soluble in hydrochloric acid, but readily soluble in potassa. The composition of this precipitate is not constant; it contains from 31·2 to 32·6 per cent of alumina, 11 of potassa, and 30 to 40 of sulphuric acid, besides water. It is therefore a basic salt approaching alunite. The formation of this salt is promoted by the presence of sulphate of potassa, but it is entirely hindered by the addition of an excess of sulphuric acid.

Structure and Generation of the Aromatic Colouring Matters.—Otto N. Witt.—The conclusions of the author are—The tinctorial power of aromatic bodies is determined by the simultaneous presence of a colouring group (*chromophore*), and of a salifiable group (*chromogene*) The chromophore exercises its influence on the saline combinations of the colouring matters more than on these same bodies in a free state. Of two colouring matters of the same structure the most solid is that whose salts are the most stable.

Facts Relating to Rosolic Acid.—MM. Liebermann and Schwarzer.—The colouring matter formed by the action of concentrated sulphuric acid upon salicylic aldehyd is easily formed. It is best to heat the mixture for an instant in the water-bath. The product dissolves in alkalies with a red colour verging upon violet; acids precipitate it anew in red flocks. It is analogous to rosolic acid, but is distinguished by the slighter solubility of its magnesian salt, by the red colour of its salts, and of the precipitate determined by acids.

Les Mondes, Revue Hebdomadaire des Sciences,
December 28, 1876.

A plant growing in Tonquin, and named *Hoang-nan*, is announced as a cure for leprosy, cancer, and the bites of venomous animals.

Solidification and Saponification of the Oil of Petroleum.—Petroleum, in consequence of an admixture due almost entirely to chance, acquires the consistence of stearin, and whilst preserving all its illuminating power becomes perfectly inexplosive. As a soap this solidified petroleum has the same detergent properties as benzol.

Several chemical papers in this issue are taken from English sources.

Reimann's Farber Zeitung.
Nos. 47, 1876, and 1, 1877.

These issues coutain nothing of general interest.

NOTES AND QUERIES.

Sulphuric Acid free from Arsenic.—Mr. H. Hasperg, of the *Chemische Producten Fabrik*, Hamburg, has learned that in many English sulphuric acid works there has been introduced a newly invented arrangement, by which arsenic is got rid of, so that the acid is absolutely free from arsenic. He desires to know full particulars, or the name of any person in England who can give him the wished-for information.

The History of Chemistry.—(Reply to "Enquirer")—Consult Rodwell's "Birth of Chemistry:" Macmillan. See also "Bibliography of the History of Chemistry," by H. Carrington Bolton: Chemical News, vol. xxxii., pp. 36, 56, 68.—A.

MEETINGS FOR THE WEEK.

Monday, 19th.—London Institution, 5.
—— Medical, 8.
Tuesday, 20th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Zoological, 8.30.
Wednesday, 21st.—Society of Arts, 8. Sir John Lubbock on "Certain Relations between Plants and Insects."
—— Meteorological, 7.
—— Geological, 8.
Thursday, 22nd.—Royal, 8.30.
—— London Institution, 7.
—— Philosophical Club, 6.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Society of Arts, 8. (Chemical Section). "Spontaneous Combustion in Factories and Ships," by C. W. Vincent, F.R.S.E.
—— Zoological, 4.
Friday, 23rd.—Royal Institution, 9.
—— Quekett Club, 8.
Saturday, 24th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."

PATENTS.—Mr. Vaughan, F.C.S., British Foreign, and Colonial PATENT AGENT. Special attention given to Inventions relating to Chemistry, Mining, and Metallurgy. "Guide to Inventors" Free by Post.—Offices, 67, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

THE CHEMICAL NEWS.

VOL. XXXV. No. 900.

ANALYTICAL NOTES.

By SERGIUS KERN, St. Petersburg.

1. *On the Estimation of Carbon.*

THE best method for estimating carbon in pig-iron and steel is the copper chloride process. The results obtained by this method are quite satisfactory for metallurgical purposes. The following remarks from my own practice may be of some use to analysts.

1. In analysing pig-iron it is quite enough to take 0·2 to 0·3 grm. of the specimen; in analysing irons and steels 2 to 3 grms. In preparing copper chloride, the solutions of copper sulphate and sodium chloride must be neutral and heated to 35°. For dissolving every 0·1 grm. of the specimen 20 c.c. of concentrated copper chloride solution is used.

2. The glass with specimen and copper chloride solution is left for two days at the ordinary temperature; every three or four hours the solution is carefully stirred with a glass rod. When no coarse particles remain on the bottom of the glass the solution is placed on a sand-bath and gently heated to 50° to 60° for about three hours. An excess of hydrochloric acid is next added and the analysis is concluded in the ordinary way.

3. Pig-irons containing manganese in notable quantities are dissolved entirely in copper chloride in about 6 to 8 days; ferro-manganese requires not less than 10 days.

4. The filtration through asbestos filters must be always executed as quickly as possible; in this case Weil's apparatus is very handy. The construction of it is described in Dr. Fresenius's "Quantitative Analysis" (sixth edition).

2. *Platinum Crucibles.*

These crucibles are not so often washed and cleaned in laboratories as is necessary. For a month experiments were made with a crucible, washed and cleaned before commencing the following experiments every month not more than four or five times.

		Grammes.
October	1, crucible weighed.. ..	20·6490
,,	5, ,, ,, ...	20·6485
,,	10, ,, ,, ...	20·6481
,,	15, ,, ,, ...	20·6479
,,	20, ,, ,, ...	20·6478
,,	25, ,, ,, ...	20·6476
,,	30, ,, ,, ...	20·6475

During this month every day two or three ignitions were made; after every ignition the crucible was washed by hot water acidulated by 10 per cent of nitric acid and dried on a spirit lamp. From the above-mentioned table it is seen that in a month the crucible lost in weight 0·0015 grm. In the same time another crucible weighing 20·6852 grms. every day was carefully washed by melting in it $HNaNH_4PO_4$, and next well polished with silica sand. This crucible had all the time a smooth bottom, and lost in weight during a month, in which it was used every day for ignitions, only 0·0006 grm.

My opinion is that platinum crucibles with a rough surface combine more quickly with the carbon of the flame than do crucibles with smooth surface. I also remarked that the sulphur (SO_2,H_2S) of the gas has a great influence on platinum, so that it was found better to purify the gas by $Pb(NO_3)_2$ in NaHO before allowing it to pass in the Bunsen burner.

Obouchoff Steel Works, St. Petersburg.

ON THE GASES CONTAINED IN METEORITES.

SECOND PAPER.

By ARTHUR W. WRIGHT, Yale College.

IN a previous article, published in the *American Journal of Science and Arts*, April, 1876, the writer gave the results of investigations upon the nature of the gases evolved from a number of meteorites of both the iron and the stony classes, when exposed to a more or less elevated temperature. The stony meteorites examined were all of the more common type, containing a considerable percentage of nickeliferous iron, without any appreciable quantity of uncombined carbon. As is well known, however, among these bodies of the stony kind, the meteorites of Alais, Kold Bokkeveld, Kaba, and Orgueil, form a distinct class, differing from the rest in several particulars, and especially in containing considerable proportions of amorphous carbon, and a bituminous substance consisting of carbon combined with oxygen and hydrogen in such a way as to simulate organic products. They are further distinguished by containing only very small quantities of metallic iron. As it seemed of interest to determine whether the conclusions arrived at in the investigations previously described were applicable to the bodies of this peculiar class also, the work was continued, with the results given below. Several other points of importance, referred to in the previous paper, were investigated, and are discussed in subsequent paragraphs.

The material used for the determinations was a fragment of an excellent specimen of the Kold Bokkeveld meteorite in the cabinet of Yale College. It contains an inconsiderable proportion of metallic iron, though this is not entirely absent, for, on filing away the surface, very minute particles may occasionally be seen. The analysis made by Harris* gives for the carbon 1·67 per cent, and for bituminous matters 0·25 per cent. As has been shown by Prof. J. L. Smith,† the mineral constituents are not greatly different from those of the ordinary stony meteorites. The method employed for the evolution and collection of the gases was essentially the same as that described in previous papers, and need not be given in detail here. It is sufficient to mention that, as the meteorite gives off a large amount of water on being heated, the tube containing the substance was connected with the pump by a recurved tube, the bend of which was placed in a freezing mixture during the evolution of the gas, in order to collect the water and prevent it from entering the pump. This tube was sealed with a gas-flame at the close of the experiment, and the water retained for examination. The temperatures employed for driving off the gaseous contents were nearly the same as those of the previous experiments, being however slightly lower, in order to avoid, as far as possible, complication of the results by the action of the heat upon the bituminous matter. The results were as follows:—

KOLD BOKKEVELD.

	CO_2.	CO.	CH_4.	H.	N.	Volumes.
300°—350°	87·34	5·08	5·93	trace ?	1·65	7·45
500°	95·53	1·32	2·14	0·54 ?	0·47	17·78
Total ..	93·11	2·42	3·25	0·38 ?	0·84	25·23

The volume of the gases obtained is much greater in this than in the previous determinations; but it will be seen that in its composition the gaseous mixture is similar to that derived from the ordinary stony meteorites, with the exception of the hydrogen, of which, if any was present, the quantity was so small as to make its determination a matter of some uncertainty. The percentage of carbon dioxide is somewhat larger at the higher temperature than in the other cases, but the real difference here is less than it appears, as the increase in the quantity of

* C. Rammelsberg, "Die chemische Natur der Meteoriten." *Abhandl. der Königl. Akad. zu Berlin.* 1870.

† *Amer. Journ. of Science and Arts*, Ser. III., xi., p. 391.

Iron Meteorites.	CO_2.	CO.	CH_4.	H.	N.	Vols.	Observers.
Lenarto	4·46	0·00	—	85·68	9·86	2 85	Graham.
Augusta Co., Va.	9·75	38·33	—	35·83	16·09	3·17	Mallet.
Tazewell Co., Tenn. ..	14·40	41·23	—	42·66	1·71	3·17	W.
Shingle Spr., Cal.	13·64	12·47	—	68·81	5·08	0·97	W.
Texas..	8·59	14·62	—	76·79	0·00 ?	1·29	W.
Dickson Co., Tenn... ..	13·30	15·30	—	71·40	0·00 ?	2·20	W.
Arva	12·56	67·71	—	18·19	1·54	47·13	W.
Stony Meteorites.							
Iowa Co.	49·51	2·64	0·00 ?	43·93	3·92	2·50	W.
Guernsey Co., Ohio ..	59·88	4·40	2·05	31·89	1·78	2·99	W.
Pultusk	60·29	4·35	3·61	29·50	2·25	1·75	W.
Parnallee	81·02	1·74	2·08	13·59	1·57	2·63	W.
Weston	80·78	2·20	1·63	13·06	2·33	3·49	W.
Kold Bokkeveld	93·11	2·42	3·25	0·38 ?	0·84	25·23	W.

hydrogen evolved at the higher temperatures, from the specimens which contained metallic iron, produced a corresponding diminution in the percentage of the carbon dioxide; neglecting this, the proportions would show a much closer correspondence. It seemed probable that, at least at the higher temperature, an appreciable quantity of some hydrocarbon of the olefiant series—that is, with more carbon atoms than are contained in marsh-gas—might be found. But both the analyses and special tests of the gas with fuming sulphuric acid showed that the quantity of such substances possibly present was too small to carry it beyond the range of the ordinary errors of observation. The bituminous substance would thus appear to have been simply volatilised by the degree of heat employed, and condensed again in the cooling tube without decomposition. No attempt was made to collect it separately.

The amount of water driven off by the heat and collected in the cooled tube was found to be about 10 per cent of the weight of the substance employed, but the determination was not entirely satisfactory. Faraday found for the water 6·5 per cent. Wöhler states that the powder dried at 120° lost 10·5 per cent more by stronger heat. Rammelsberg found that the total loss at a strong heat was 15·24 per cent; but this of course includes, besides the water, the gases evolved and the volatile bituminous substance, as well as some sulphur, which was observed to be volatilised. The water, on the application of the ordinary tests, gave distinct evidence of the presence of chlorine, and less certainly of sulphurous oxide, resembling in these respects that derived from other meteorites. A small quantity of a light yellowish substance was deposited in the cold part of the tube, which appeared to be sulphur, but was not specially examined.

The differences in the gaseous products obtained from meteorites of the different classes may be made more apparent by bringing together the results of analyses hitherto made. The following table gives the total percentage of the gases yielded by the different specimens, the first seven being irons, the remainder belonging to the stony class. It represents the composition of the total amount of gas given off up to incipient or low red-heat, except in the first two instances where the temperature employed was much higher.

In the case of the last of these meteorites the number given in the table does not express the whole volume of gas contained in it, as the experiment was discontinued before it ceased to be given off. A special determination made with a separate portion gave a little more than thirty volumes. The Arva meteorite also is exceptional both as regards the volume of gas yielded by it and with respect to the large volume of the carbonic oxide obtained. We are reminded, by this fact, of the Ovifak iron, from which Wöhler obtained, by heating it to redness in an iron tube, more than 100 volumes of gas which was found to be carbonic oxide mingled with a little carbon dioxide.* He attributes it, however, to the action of the carbon upon some oxygen compound, and the mass was found to contain a large quantity of magnetic oxide of iron. Doubtless the result was affected by the employment of the iron tube, which would rapidly reduce the carbon dioxide at such a temperature. Berthelot, who examined another portion, at M. Daubré's request, obtained, by slow calcination in a tube of Bohemian glass, a large volume of gas, the precise amount of which is not stated, consisting chiefly of the two oxides of carbon in nearly equal quantities.* The celestial origin of the Ovifak iron is very doubtful, however, and its composition is different from that of the Arva meteorite, in which no oxygen compounds were detected.

A few words need to be said with reference to the volumes quoted in the case of the Tennessee, Texas, and Arva irons. In an article published in the *American Journal of Science and Arts*, for April, 1875, giving an account of a spectroscopic examination of the gases from these bodies, it was stated that the volumes were as follows:—Tennessee, 4·69; Texas, 4·75; Arva, 44+; whereas the volumes as determined in the subsequent investigations by actual measurement were 3·17, 1·29, and 47·13 respectively, as given in the table. The discrepancy is due to the fact that the former numbers were calculated from the change in the reading of the gauge of the air-pump on evolution of the gas, and were not corrected for the small amount of water vapour present. Where the quantity of gas was small the error from this source was considerable, and the result would have only the value of a rough estimate. In the case of the Arva iron, where the volume of the gas was much larger, the inaccuracy was not serious, and the volume corresponds much more nearly with the true result as obtained from measurement. In the later determination of the volume of gas from the Texas iron, moreover, the metal was in rather coarse fragments, and the evolution of gas from it was not as complete as in the previous case. That the amount of gas obtainable from this iron should approximate to that obtained from the Tennessee specimen, if the trial were made with finely pulverised metal, is clearly indicated by the results of the earlier experiments.

The necessity for the precautions mentioned in the previous paper respecting the degree of heat employed and the time of its application, was well shown in the repetition of the experiments with the Iowa meteorite. The reducing action of the metallic iron upon the carbon dioxide, though not very apparent at comparatively moderate temperatures, becomes considerable as the temperature rises, and in some of the experiments where the heat was carried nearly to redness, and prolonged beyond what was necessary for the evolution of the larger part of the gas it was found that the amount of carbonic oxide was very variable, in one instance reaching to 12 or 13 per cent. This explains also the larger amount of this gas obtained in the preliminary examination of last year, where the analysis gave 14 per cent, as no special attention was at that time given to this source of error. It is also clearly

* *Pog. Ann.*, 146, p. 297.

* *Comptes Rendus*, lxxiv., 1545.]

shown by the following experiment with a portion of the Weston meteorite. After the gas had been driven off from this by a red-heat, pure dry carbon dioxide was admitted into the pump, and the tube heated nearly to redness for about half an hour. On pumping out some of the gas and analysing it, it was found that nearly 20 per cent of it had been converted into carbonic oxide. Although great care was taken in all the subsequent work to avoid this source of inaccuracy as completely as possible, the percentages of this gas obtained at the higher temperatures are less certainly to be depended upon than the others. The amount of marsh-gas obtained also shows a certain correspondence with that of the carbonic oxide, as if—possibly in the reaction by which the carbon dioxide was broken up by the iron—a portion of the carbon combined with the hydrogen present to form marsh-gas, a supposition which is not without warrant from the conclusions of other observers.* But though some degree of uncertainty may attach to the numbers given for the higher temperatures, the fact that, with all the precautions observed in the experiments, the gases were found to be present in small quantities, even at the lowest temperatures at which examination was made, renders it probable that the results are not far from the truth, and that carbonic oxide and marsh-gas are really to be reckoned among the gaseous contents of the stony meteorites, and that the same cause which produced the one in greater or less quantity had a similar effect upon the other.

Among the questions discussed in the previous paper was the manner of the occurrence of the carbon dioxide. This has been subjected to further examination, with the result of modifying somewhat the conclusions there arrived at. That it has been derived from the atmosphere by absorption subsequently to the fall of the body is improbable; for not only did the re-examination of the Iowa meteorite show a loss rather than gain with the lapse of time, but also there would seem to be little reason for a selective action of the mass, which would enable it to take up this gas in preference to the other atmospheric constituents, unless it were the fact of the feebly acid character of the carbon dioxide, as in the presence of or combined with water. But in this case the carbonates formed by combination with the oxides present in meteoric masses would be very stable compounds, and quite incapable of decomposition at the low temperatures employed.

The explanation was suggested in the earlier papers that the gas was condensed upon the finer particles of the metallic iron, as well as absorbed within it. With a view to test the correctness of this supposition, a special set of experiments was undertaken. A quantity of the substance of the Iowa meteorite was reduced to fine powder, and the iron extracted from it with a magnet, and kept by itself. The grains of iron were then rubbed repeatedly in an agate mortar, to free them as completely as possible from the adhering stone, from which they were separated as before, the residue of the powder being added to that left by the first operations. The material was thus divided into two portions, one of which consisted chiefly of the stony matter, the other principally of the iron. For a third portion pieces of the meteorite were simply broken into small fragments, and not pulverised. Each portion was placed in a clean tube, and in its turn attached to the pump for examination, care being taken to subject each, as nearly as was possible, to the same degree of heat and for the same length of time. The highest temperature employed was below that of red-heat. The following were the results obtained:—

	CO_2 and CO.	H.	N.	Volumes.
Powder ..	66·96	30·96	2·08	0·97 } 1·48
Iron	38·72	59·38	1·90	0·51 }
Fragments ..	48·07	50·93	1·00	1·87

Although, from the nature of the case, no very precise result could be expected from this mode of experiment, inasmuch as it was impossible either to separate the iron entirely from the mineral portion, or to free the iron completely from the stony matrix, the numbers above given indicate clearly that the stony portion yields a considerable portion of the gas given off at the temperature employed, and that this contains a larger proportion of the carbon oxides than that obtained from the iron, which, on the other hand, is richer in hydrogen. The product of the stony fragments is, in its composition, approximately a mean between the two others, as was to be expected; but it will be seen that the volume obtained was somewhat larger, showing that a portion of the gas was lost in the process of pulverisation. These facts would seem to indicate that, while a portion of the gas may be condensed upon the fine particles of the iron, as at first conjectured, a large part of the carbon dioxide, and possibly also of the water, carbonic oxide, and other gases, is mechanically imprisoned in the substance of the meteorite. Now Mr. Sorby has shown* that the meteorites of Aussun and Parnallee, when examined in thin sections under the microscope, contain numerous small cavities filled with gas, similar to those which have been observed in many terrestrial minerals. It will be noticed that the Parnallee meteorite was one of those examined by the writer, and found to yield 2·63 volumes of gas on the application of heat.

The occurrence of carbon dioxide in cavities of minerals, under a pressure so great as to cause it to be in the liquid condition, as also associated with water, has been often observed, and has been quite recently proved in an ingenious and satisfactory manner, by Mr. Hartley,† for a large number of different minerals. Similar gas-cavities have been shown also to exist in many eruptive or volcanic rocks, for examples of which we need only to refer to Mr. Sorby's and Mr. J. C. Ward's papers in the *Quarterly Journal of the Geological Society*, and to other memoirs published elsewhere. The actual extraction and chemical examination of the gaseous contents of these bodies appears to have attracted little attention thus far, though they might lead to results of great interest and importance. Some incomplete experiments by the writer may be mentioned here, as illustrations, though but little weight is attached to them as quantitative determinations. A quantity of pulverised trap-rock was subjected to a heat which was raised to incipient redness, the examination being conducted by the same method as that employed upon the meteorites. The mineral gave off about three-fourths of its volume of mixed gases, which were found to contain about 13 per cent of carbon dioxide, the residue being chiefly hydrogen. Another specimen of trap, containing small nodules of anorthite, was examined, at the request of Mr. G. W. Hawes, who had observed gas-cavities in a thin section of the mineral prepared for microscopic examination. This gave off somewhat more than its own volume of gas, which was found to contain some 24 per cent of carbon dioxide. The gas in these cases was not given off as readily as from the meteorites, and was evolved rather suddenly as a temperature approaching red-heat was reached. If it should appear improbable that the large amount of gas contained in the Kold Bokkeveld specimen could be retained in this way, it may be suggested that the amorphous carbon contained in it is a substance peculiarly fitted to absorb and retain large volumes of gas. These results would seem rather to assimilate the stony meteorites to terrestrial rocks of volcanic origin, than to place them in a different category, and to strengthen the evidence that they are themselves the product of igneous action, though modified profoundly in some respects in their structure, by the influence of other forces and the circumstances of their formation. The supposition of the imprisonment of the gas in the stony substance would also serve to explain why the water, which cannot be separated by a temperature of 100°, con-

* Watts's "Dictionary of Chemistry."

* *Proc. Royal Soc.*, June 16, 1864.

† CHEM. NEWS, June 9, 1876, p. 257.

tinues to be given off even at the highest temperatures employed, as has often been observed in experiments with meteorites.

It has been pointed out by astronomers that on arranging the mean distances of the asteroids in a series, there are found to be certain gaps in the list, as if some members were wanting. Now it is further found that the periodic times of these missing bodies stand in a simple relation to the time of Jupiter's revolution, and in such a way that his continued action upon them would accumulate the perturbative effects, tending to throw their orbits into eccentric forms. Such of the bodies as were caused to move in very narrow orbits, with shortened period, would be exposed to very great vicissitudes of temperature, and during the part of the orbit near the sun not only would the change of temperature be comparatively rapid, but the actual degree of temperature reached would be very considerable, especially considering the fact that these bodies are of too small mass to permit them to retain an atmosphere of any appreciable amount. It is not difficult to see that these great changes of temperature, in a mass of considerable absorptive and low conducting power, must give rise to powerful stresses, and that under the intense action of the sun near the perihelion the action may be sufficiently energetic to cause the splitting up of the bodies themselves. The disruptive action requisite to separate a mass from the principal body entirely, and so as not to return, would be less as the mass of the body is smaller, and would, for a mass no larger than some of the asteroids, be quite within the range of possibility. The body would thus be subject to a continuous process of disintegration in its successive revolutions, and must end in being broken up into a swarm of fragments which would gradually be distributed over the entire orbit. Such an action appears to be really going on in some of the comets, and moreover the orbits of several of them are coincident with those of great meteoric streams, in which the process of disaggregation has already gone very far. Now, of the comets of short period a considerable number are grouped with their orbits in such a relation to that of Jupiter as to suggest the possibility of their derivation from the asteroids. Similar considerations also apply to the group of comets associated with the orbit of Neptune, the existence of which suggests the question whether there may not be another group of asteroids, exterior to this body, yet remaining to be discovered. But without assuming the asteroidal origin of these comets, the effects of solar heat just described may be safely predicated of them, as well as of other comets or meteoric masses revolving in excentric orbits.

This process of disintegration, in the earlier stages of the history of one of these bodies, would constantly present fresh surfaces for the action of the sun's rays, which must cause the evolution of large volumes of gas, and the rifts and fissures produced by the cooling at aphelion would allow the gas contained in the interior of the body to stream off under comparatively little increase of temperature. This gaseous matter, expanding into empty space and streaming off, forms the tail of the comet, which is driven away from the sun's direction by some repellent force possibly due to electrical action. That the amount of gaseous substance furnished by such a body should be sufficient to form a luminous train of the immense extent often observed in comets need not appear incredible, if we reflect that of a substance like the Kold Bokkeveld meteorite every cubic mile would furnish 30 cubic miles of gas at the pressure of the terrestrial atmosphere, and that this in space would be speedily expanded to enormous dimensions, before it would cease to be capable of transmitting electric discharges, or to be visible by reflected sunlight. As the masses of some of the comets have approached planetary dimensions there is no difficulty in accounting for the enormous trains some of them have exhibited. Moreover, there is reason for believing that the meteorites which reach the earth are the spent fragments, as it were, which have already parted with a considerable portion of their gaseous constituents by the long-continued action of the sun as above described, so that the amount of gas contained in some of these celestial bodies may be even much larger than that we observe in actual meteorites. We may also take into account the not inconsiderable amount of water contained in these bodies, to say nothing of the volatile carbonaceous matters which are present in some of them.

Besides the relations mentioned above may be cited the near correspondence of the average density of the stony meteorites with the calculated density of the asteroids, which, though possibly accidental, is certainly suggestive of a community or similarity of origin.

Additional and most striking testimony to the real connection of the meteorites and comets is afforded by the close resemblance of the spectrum of the gas obtained from the stony meteorites to the spectra of those comets which have thus far been observed.

Many observations respecting this point were made upon the gases collected from the various meteorites examined in the course of the investigations which have been described. Vacuum-tubes, of the form usually employed in spectroscopic work, were attached to the pump and filled by the meteoritic gases as they were evolved. After the latter had been pumped out for the most part into the collecting-tube, a freezing mixture was applied to one of the tubes of the pump and allowed to remain until the watery vapour was condensed, thus rendering the gas in the vacuum-tube very nearly free from moisture. As the vapour of mercury is always shown by spectroscopic examination to be present in tubes filled in this way by the use of a mercury-pump, small pellets of clean gold-foil were previously placed in the tubes, in order to absorb the metal. This proved to be quite effectual in some cases, in others only partially so. The tubes, having now been sufficiently exhausted by the continued action of the pump, were removed, sealed, marked, and preserved for examination.

On passing the discharge of an induction-coil through these tubes when placed before the slit of a spectroscope, a spectrum is seen, which varies with the conditions. That from the capillary portion of the tube shows the hydrogen lines brilliantly, together with the bands due to carbon compounds. In the wide part, however, the hydrogen lines are entirely absent, only the carbon bands being visible. When the illumination is sufficiently strong these are five in number, all sharp at the least refrangible edge, and fading gradually away at the other. When the slit is narrowed, or the tube removed to a greater distance so as to diminish the intensity or the light, only three remain visible, namely, one beginning in the yellowish green, one in the green, and another in the greenish blue. Of these the middle one is by far the brightest, and when the light is very much enfeebled remains visible after the others have disappeared. Of the latter, the one in the greenish blue is brighter than the other. A resemblance to the spectra of the comets is apparent at a glance, not only in the positions, but also in the form and relative brightness of the bands. A closer comparison, however, shows a marked difference in their breadth, the cometary bands, as represented by various observers, covering a considerably greater space. There appeared also to be a want of exact coincidence in their positions. For the first two the difference was not greater than the discrepancies of the results given for different comets, and the bands agreed very well with some of the observations. The third band showed a greater divergence.

As the greater breadth of the cometary bands indicates a density of the cometic gases greater than that in the tubes examined, an experiment was made, as follows, for the purpose of observing the effect of increasing the density of the gas. A glass tube, having an internal calibre of about 1 centimetre and some 20 centimetres in length, was closed at one end, and through the sides were inserted two platinum wires, at points near the middle of the tube, the inner ends of the wires being in its axis and separated

by an interval of about 1 centimetre. Small fragments of the Kold Bokkeveld meteorite were dropped into the tube and shaken down into the closed end. The upper end was now drawn out to a narrow neck, and the whole attached to the pump. After exhausting the air, the neck was sealed, the tube withdrawn, and supported in a vertical position so that the interval between the wires was before the slit of the spectroscope, the end containing the meteorite being below. By means of wires connecting the platinum points with an induction-coil, sparks were passed across the interval, and when the lower end of the tube was gently heated the characteristic spectrum of the gas evolved became visible. At first it was very similar to that which had been observed previously, but as the heat was increased, and the pressure of the gas became greater, the bands were seen to widen out, until they at length fully equalled in breadth those of the comets, and finally they showed a tendency to run together. In the order of their relative intensity there was no appreciable change.

The slight disagreement in the positions of the first two bands with the reported observations of cometary spectra is readily explained when we consider that for the latter a rather wide slit is necessary in order that they may be distinctly seen. If the object viewed were a sharp fine line, the effect of opening the slit would be merely to increase its breadth without affecting the sharpness of the edges. It is easy to see, however, that a band, though with a narrow slit the edge were sharp and brighter than the other parts, would have its point of maximum brightness removed toward the middle of its breadth, and the farther as the opening were greater. The effect of this would be that a faint band would appear hazy at the edge, and the tendency would be to displace its apparent position towards the brightest point. Further, the measured position of the edge would be affected by the change of place of the movable edge of the slit. A simple experiment with the tube showed that the alterations from these two sources were sufficient to account for the apparent want of agreement in the positions of the bands, and also to explain some of the discrepancies in the results of different observers, as to the position of the cometary bands, especially when regard is paid to the faintness of the light and the consequent difficulty of precise determination. Measurements of the first two bands, with the slit rather wide and the intensity of the light sufficiently diminished, were found to coincide very satisfactorily with the best recorded observations upon the corresponding bands in the spectra of comets. For the third band the result was less satisfactory, as it appears to be somewhat less refrangible than its cometary analogue, as determined by the majority of observations of the latter, though it agrees very well with some of them. Not improbably, however, the hydrocarbons existing in small quantities in some of the meteorites may be present in the comets in sufficient amount to modify their spectra somewhat.—*American Journal of Science and Arts.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 15th, 1877.

Dr. J. H. GILBERT, F.R.S., Vice-President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the names of Messrs. A. Angell, F. W. Young, E. W. Napper, and H. G. Stacey were read for the first time. Messrs. Michael Conroy, Arthur Pearson Luff, John Angell, Joshua Bardsley, Matthew Algernon Adams, and Peter Townsend Austen were ballotted for and duly elected, after their names had been read the third time.

The CHAIRMAN, in accordance with the bye-laws, announced the proposed changes in the Council and Officers of the Society for the ensuing year. It is proposed to elect Dr. J. H. Gladstone as President in place of Professor Abel, who retires. The Vice-Presidents are Mr. Field and Dr. Roscoe in place of Mr. Longstaff and Dr. Gladstone. The other members of Council are Messrs. I. Lowthian Bell, C. E. Groves, W. N. Hartley, T. Hyde Hills, and G. Matthey in place of Messrs. D. Campbell, J. Dewar, F. Field, N. Story Maskelyne, and W. Valentin.

The first paper was by Dr. A. DUPRÉ, "*On the Estimation of Urea by means of Hypobromite*," the object of the communication being to describe a form of apparatus which could be conveniently worked, and such modifications in the preparation of the hypobromite solution as to prevent the escape of any bromine vapour, so that the process might be used in the wards of an hospital. The apparatus consists of a burette inverted in a tall cylinder of water, and connected by a side tube with the generator by means of a long piece of caoutchouc tube. The generator containing the proper quantity of hypobromite is a bottle closed by a vulcanised cork, through which passes a short tube to connect it with the burette, and also having a small test-tube attached to it to contain 5 c.c. of the urine under examination. After the cork has been firmly inserted the urine is mixed with the hypobromite by gently inclining the generator. The latter is briskly agitated for a short time, and then plunged into cold water. After allowing the apparatus to stand a few minutes to cool the gas to the same temperature as the water, the level of the liquid inside and outside the burette is made the same by raising the latter, and the reading of the gas taken and also that of the thermometer. The necessary quantity of hypobromite is easily prepared by pouring into a stoppered cylinder enough caustic soda solution (100 grains to 250 c.c. of water) to fill it up to a 25 c.c. mark on the side, introducing a thin sealed tube containing 2·2 c.c. of bromine, and agitating briskly so as to break the thin tube. The amount of nitrogen given off is found to be 91 per cent of the total quantity in the urea, and the burette may be so graduated that it gives readings of the percentage of urea at the normal pressure and temperature.

The CHAIRMAN said they were much indebted to the author for facilitating the process for the estimation of urea, one of the most important in hospital practice, as showing the amount of nitrogen eliminated by the renal organs. Although urea represents nearly all the nitrogen in the urine of the human subject, this was not the case with the ruminants.

Dr. C. R. A. WRIGHT remarked that in some experiments on this method of determining urea, made in his laboratory by Dr. Blackley, a slightly higher percentage of nitrogen had been obtained, about 93 per cent. The apparatus described by Dr. Dupré possessed considerable advantages over those of Russell and West and of Dr. Blackley, as there was no danger of spilling the corrosive hypobromite solution if ordinary care were taken: at the same time, in agitating the generator, the latter might get heated, and thus increase the reading.

Prof. HARTLEY suggested the substitution of a gutta-percha tube for holding the urine in the generator in place of the fragile glass one.

The next communication was on "*A New Carbometer for the Estimation of Carbonic Anhydride*," by Mr. S. T. PRUEN and Dr. G. JONES. It is somewhat similar to Scheibler's "calcimeter," consisting of two equal graduated glass tubes filled with water, on the surface of which a layer of oil floats, and connected with each other by a piece of caoutchouc tubing. One of these is raised or lowered automatically, the other is fixed, and connected at its upper extremity with the generator by means of india-rubber tubing, a chloride of calcium tube being interposed between the generator and the measuring tube. The generator consists of a small flask, in which a weighed quantity of the carbonate under examination is place-

together with a small gutta-percha tube containing hydrochloric acid. The decomposition is effected in the usual way, and the evolved gas measured, the barometric pressure being taken, and the temperature observed by means of a thermometer in the measuring-tube. Tables of data for the necessary corrections accompany the paper. The authors state that it is more convenient than Scheibler's apparatus, as it is less cumbersome, the tubes do not require refilling or emptying, and it is self acting.

Mr. WARINGTON observed that there was a source of error in the Scheibler instrument which also attached to this apparatus, namely, that the correction to be applied for the carbonic anhydride dissolved by the hydrochloric acid was the same whatever the percentage of carbonic anhydride, whereas if there was much air and comparatively little carbonic anhydride in the flask at the close of the experiment the hydrochloric acid would absorb but little of the carbonic anhydride, whilst if the air were rich in carbonic anhydride the acid would absorb more of the latter.

Dr. DUPRÉ called attention to the fact that although the gas was dried by passing over the calcic chloride it must become wet by contact with the moist sides of the measuring-tube, to which

Dr. JONES replied that it was found practically that the film of oil prevented the gas from coming in contact with the water, and thus becoming moist.

The next paper was "*On the Influence Exerted by Ammonium Sulphide in Preventing the Action of Various Solutions on Copper*," by Messrs. F. W. SHAW and T. CARNELLY. Clean pieces of copper-foil of known surface were coated with a thin film of sulphide by immersion in dilute ammonium sulphide, and subsequently thoroughly washed. The results of the action of distilled water, and of various solutions on these as compared with similar pieces of clean copper, are given in a series of tables, from which it appears that the film of sulphide does not lessen the action of distilled water, but, on the contrary, increases it, both at the ordinary and at elevated temperatures: this is due to the oxidising action of the air, as shown by the results obtained in closed flasks completely filled with water that had previously been well boiled. In the case of saline solutions the film of sulphide lessens the action on the metal; the salts experimented with being potassic nitrate, sulphate, and carbonate; sodic chloride, nitrate, and carbonate; magnesic sulphate; and ammonic chloride, nitrate, and sulphate.

The CHAIRMAN having thanked the author,

The SECRETARY read "*An Experimental Enquiry as to the Changes which occur in the Composition of Waters from Wells Near the Sea*," by Mr. W. H. WATSON. The well examined was about 9 feet deep, the bottom being 24 feet above the level of the sea, and was situated at Brystones, near Whitehaven, about half a mile distant from the sea. Determinations of the chlorine were made each day, the water being collected at about 10 a.m., and the results are given in a table. The amount of chlorine varied from 5·95 to 17·50 grains per gallon, whilst the other constituents, such as sulphates, remained almost constant. The author considers the variation observed in the water of this well, situated in an alluvial soil, to be due chiefly, but not entirely, to the weather, as from the nature of the intervening strata it may be directly subject to infiltration of sea-water.

Mr. F. MAXWELL LYTE said that he had examined the mineral water at the Source de Salut, Bagnères de Bigorre during many years, and had found that from October to December an extraordinary change took place in the nature of the water, as it became sulphureous, and the quantity of salt in it increased. It was probable that the deep spring was sulphureous, but became altered by the infiltration of other springs near the surface, which after the droughts of summer partially dried up: thus the supply of oxygen being partially cut off the spring resumed its sulphureous character.

Mr. C. E. GROVES remarked that springs in alluvia soils near the sea might derive much of their chlorine from the scud driven over the land in stormy weather, and which, settling on the land, was washed in along with the surface-water by subsequent rains.

The CHAIRMAN, in thanking the author, said it was necessary to know all the circumstances connected with the well before the source of the large amount of chlorides in it could be definitely accounted for.

"*On the Solvent Action of Various Saline Solutions on Lead*," by Mr. M. M. P. MUIR. The author, from an examination of the action of various saline solutions on lead, infers that in the first place a soluble salt of lead is produced, which by the action of carbon dioxide absorbed from the atmosphere is slowly converted into hydrocarbonate, in which form it is, to a greater or less degree, precipitated. In certain solutions, especially those containing ammonium nitrate and calcium chloride, the formation of the soluble lead salt proceeds more rapidly than its precipitation as hydrocarbonate, although after long periods the latter action preponderates. Lastly, carbonates reprecipitate the soluble lead salt in the form of hydrocarbonate as fast as it is produced. A table showing the solubility of lead hydrocarbonate in the saline solutions examined is appended to the paper.

The CHAIRMAN having thanked the author,

Two other papers were read by the SECRETARY, the first being a preliminary notice on "*The Derivatives of Di-Isobutyl*," by Mr. W. CARLETON-WILLIAMS. The di-isobutyl employed in the investigation was prepared by the action of sodium on isobutyl bromide, and boiled at 109° C. Submitted to the action of chlorine it yielded a liquid possessing an odour resembling that of the orange, and consisting of a mixture of iso-primary and iso-secondary octylic chlorides boiling at 170° to 180°. The mixed chlorides heated with potassic acetate and acetic acid at 200°, yielded, besides the octylic acetates, an octylene boiling at 122°, and which had a specific gravity of 0·7526 at 16°. The mixed acetates boiled at 193° to 205°, and by treatment with potassic hydrate were converted into a mixture of the primary and secondary octylic alcohols boiling at 175° to 187°, the quantity of which was too small to permit of any attempt at separation. It was therefore oxidised by potassium dichromate and sulphuric acid, when it yielded iso-caprylic acid and an aceton, which on further oxidation split up into acetic and carbonic acids. From these results it would seem that the secondary alcohol is isopropyl-isobutyl-carbinol,—

$$CH(CH_3)_2.CH(OH).CH_2.C(CH_3)_2,$$

whilst the primary alcohol may be represented by the formula—

$$CH(CH_3)_2.CH_2.CH_2.CH(CH_3).CH_2(OH)$$

The isocaprylic acid is an oily liquid, somewhat resembling valerianic acid in odour. Its silver salt is slightly soluble in boiling water, and is deposited on cooling in minute tooth-shaped crystals. The barium lead and zinc salts are amorphous, but the calcium salt is characteristic, crystallising in plates radiating from a central point. It is less soluble in hot than in cold water, so that on raising the temperature of a solution saturated at 15° to 36° C. the salt is precipitated.

"*Notes on Madder Colouring Matters*," by Dr. E. SCHUNCK and Dr. H. RŒMER. The first of these describes a method of detecting small quantities of alizarin in mixtures of alizarin and purpurin by exposing the solution of the substance in caustic alkali to the air until it has become almost colourless: the purpurin is thus decomposed, and on agitating the acidified solution with ether the alizarin is taken up, and may be recognised in the usual manner by its absorption-spectrum. The second note is on "*Purpuroxanthic Acid, a Colouring Matter Found in Commercial Purpurin*," from which it was separated by boiling it with alum liquor, precipitating by hydrochloric acid, and extracting the precipitate with alcohol. A residue containing alumina was left, which gave purpuroxanthic acid by crystallisation from alcohol mixed with a

little hydrochloric acid. This acid may also be obtained from the alcoholic mother-liquors obtained in crystallising commercial purpurin, by evaporating them, boiling the residue with water, and adding hydrochloric acid to the filtrate, which throws down the impure purpuroxanthic acid as an orange precipitate. It is purified by boiling it with baryta, which dissolves the impurities, and leaves the acid as a baric salt. Purpuroxanthic acid, $C_{15}H_8O_6$ or $C_{14}H_7O_4.COOH$, crystallises in yellow lustrous needles or scales, which are easily soluble in alcohol or acetic acid, and far more so in boiling water than most madder products. It melts at 231°, and at 232° to 233° C. decomposes, giving off carbonic anhydride, and leaving purpuroxanthin, $C_{14}H_8O_4$, no other substance being produced. Purpuro-xanthic acid dyes alumina and iron mordants orange and brown respectively, but the colours are very fugitive.

The CHAIRMAN having thanked the authors, adjourned the meeting until Thursday, March 1, when there will be a lecture by Professor T. E. Thorpe, "On the Theory of the Bunsen Lamp."

PHYSICAL SOCIETY.

February 17th, 1877.

Professor W. G. ADAMS, Vice-President, in the Chair.

MR. T. W. PHILIPS, C.E., was elected a Member of the Society.

Prof. GUTHRIE exhibited for Mr. C. J. Woodward an apparatus he has devised for showing to an audience the interference of transverse waves. A light frame, capable of moving in a vertical plane, carries a horizontal strip of tin about 2 feet in length, cut in the form of the ordinary sine wave, and which supports by means of a pulley a light wooden block carrying an ink recorder in front of a sheet of paper. This block slides in a vertical slot in a piece of wood, which can be moved horizontally, supported by a roller on another similar strip of tin fixed parallel to the first, and vertically below it. The movable frame rests on a castor attached to this block. If the relative positions of the waves be now varied, and the blocks moved along them, the path traced by the ink recorder will represent the wave due to their combination.

Mr. S. P. THOMPSON exhibited some galvanometers in the form of magic-lantern slides which he has arranged for exhibiting their indications to an audience. The instruments are, however, only capable of indicating comparatively powerful currents, and he hopes to succeed in arranging forms of greater sensitiveness. The index-needle is usually formed of cardboard, and two small steel needles are attached to it parallel to its axis. It is pivoted lightly between glass plates, and influenced by the current traversing coils of wire placed beyond the circle in which it rotates. The best effects were obtained by means of two curved electro-magnets surrounding a small steel magnet, but this form is inapplicable to quantitative determinations on account of the residual magnetism of the iron cores. A gold-leaf electroscope formed on this principle was capable of detecting very small charges of statical electricity.

Mr. WILSON then showed an arrangement for exhibiting convection currents in heated water. It consists of a small glass cell with parallel sides. In the base of the wood dividing the sides is cut a slight depression to expose a brass tube which traverses it horizontally, and is open at one end, while the other is bent at right angles, and connected with a flask containing water. The brass tube, where it is exposed in the cell, is surrounded with a jelly formed of gelatine containing rosanilin, and the cell is filled with water, and projected on the screen. When the tube is heated by boiling the water in the flask, the jelly is liquefied, and the liberated colouring matter rises in the water, showing the direction of the heated current.

Prof. GUTHRIE exhibited an arrangement he has been using with a view to determine the vapour-tension of water, and explained the difficulties to which such a determination is liable, and the manner in which his apparatus has so far failed. It was shown that a crystal of alum, or a saturated solution of salt, when introduced into the Torricellian vacuum, depresses the mercurial column less than pure water, whereas solutions of size, gum-arabic, or any colloid, depress it to precisely the same extent. It thus appears that water in its different states of combination has different vapour-densities, and their determination requires an arrangement in which the several substances can be easily introduced into the Torricellian vacuum, and very slight changes of the level of the mercurial column can be ascertained. Prof. Guthrie has been employing a U-tube 33 inches long, one extremity of which is bent, and terminates in a capillary opening, and a bulb is formed at the U-bend. If the substance under examination be introduced at the open after the apparatus has been filled with mercury, inverted, and the superfluous metal escaped, the mercury expelled through the capillary opening will give a measure of the amount of depression.

Prof. MCLEOD suggested a modification of this form of apparatus.

Prof. GUTHRIE then showed the manner in which electricity is distributed on non-conductors, such as the plate of an electrophorus, by placing it for a given time beneath a point connected with a charged Leyden jar, and subsequently sprinkling a mixture of sulphur and litharge over it. It was shown that the diameter of the circle formed below the point after the superfluous powder had been removed was not purely a function of the distance between the point and the plate, but is mainly influenced by the conductivity of the material, and, further, that if the point be directed obliquely towards the plate, the circle formed is very slightly elliptical, but the ellipticity is in no degree proportionate to the obliquity of the point; and, finally, he showed that if the non-conducting plate of an electrophorus be written upon with a metal, and sprinkled with the above mixture of sulphur and litharge, the former or latter adheres according to the nature of the metal used, and he suggested that some such arrangement might be employed as a kind of electrical touchstone for discriminating between certain metals.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

February 12th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

F. TIEMANN and H. HERZFELD stated that they had obtained coumarin directly from the acetyl compound of ortho-coumaric acid by heating it to a temperature of 150°:—

$$C_9H_7O_3.C_2H_3O_3 = C_9H_6O_2 + C_2H_4O_2.$$

The melting-point of the ortho-coumaric acid lately obtained by them from salicylic aldehyd was found to rise by repeated crystallisations until it coincided with that of the acid obtained by Perkin, 207°. This varies but 1° from that of the para-coumaric acid lately prepared by them, and the two acids possess the same general appearance and solvent properties: they are, however, sharply distinguished from each other by the fluorescent properties of the potassic solution of ortho-coumaric acid not possessed by the para acid, and by the widely divergent character of the hydro-acids yielded by treatment with sodium amalgam.

A. FRANCK devoted a few words to the memory of the lately deceased chemist, S. Lindemann, of Stassfurt.

C. A. MARTIUS gave a detailed account of the petroleum industry of America.

The following communications have been received from non-resident members:—

A. WÜLLNER, in response to a late communication of F. Müller, defends the theory that the temperature of the aqueous vapour escaping from boiling solutions of salts lies above 100°.

C. HENSGEN describes the results of the "*Action of Dry, Gaseous, Hydrochloric Acid upon Magnesium Sulphate.*"

J. JOBST gives a detailed account of "*The Crystalline Components of the Bark of the Coto Tree of Bolivia.*" A number of these have been separated and analysed: they are mostly homologous to the chief ingredient, paracotoin, $C_{19}H_{12}O_6$. This body crystallises in yellow laminæ, is not easily soluble in ordinary solvents, and by treatment with BaO is changed into para-cotoinic acid, $C_{19}H_{14}O_7$, Alkalies change it into para-coumarhydrin under separation of carbonic acid:—

$$C_{19}H_{12}O_6+2H_2O=CO_2+2C_9H_8O_3.$$

S. SYLVESTRI has discovered the presence of "*Paraffin in Lava Blocks.*" The quantities enclosed were sufficient to enable him to separate out and identify several hydrocarbons.

M. CONRAD and W. R. HODGKINSON, by the "*Action of Sodium upon Acetate of Benzyl,*" have obtained the benzylic ether of an hydro-cinnamic acid,—

$$C_6H_5.CH_2.CH_2.COO.CH_2.C_6H_5.$$

G. SCHULTZ has examined the products resulting from the "*Decomposition of Oil of Turpentine at a High Temperature.*" The decomposition was effected in an iron tube heated to a dull red-heat, and from the black tar which resulted the following hydrocarbons were separated out:—Benzene, toluen, xylen (principally 1 : 3), unchanged oil of turpentine, naphthalin, phenanthren, anthracen, and methyl-anthracen.

R. DYCKERHOFF, "*On Derivatives of Monochlor-acetophenon.*" By treatment with KSCN he has obtained the sulpho-cyanic ether, $C_6H_5.COCH_2S.CN$, but is unable to isolate the mercaptan, $C_6H_5.COCH_2SH$. Acetophenon gives with phosphorus pentachloride, a mono-chloro styrol.

W. BÖRNEMANN has found, in experiments "*On the Formation of the Chlorides of Iodine,*" that ClI is soluble in dilute HCl, without causing a separation of iodine. If chlorine is led into water containing iodine until the latter disappears, a slight separation of iodic acid occurs only when the solution is very concentrated. If it is attempted to change all of the iodine present into iodic acid, the solution must be at least so dilute as to contain water and iodine in the proportion of 1 : 10. If chlorine is conducted into a concentrated solution as long as it is absorbed, IO_3H and ICl_3 are precipitated.

W. KÖNIGS has obtained the "*Ethyl-Ether of Amidophthalic Acid,*" $C_6H_3(NH_2)(COOC_2H_5)_2$, by reduction of the ethyl-ether of nitro-phthalic acid with zinc and hydrochloric acid, at a low temperature.

V. MEYER, J. BARBIERI, and F. FORSTER have made a careful study of the "*Products resulting from the Action of Nitrous Acid upon Normal Butylamin,*" and ascertained that the statement of Linnemann and Zotta, with regard to the formation of primary isobutyl alcohol by this reaction, is an error. A part of the amine is changed into normal butyl alcohol; the greater portion is decomposed into water, nitrogen, and butylen. Of this butylen, part escapes as gas, and part unites with water to form secondary butyl alcohol. No trace of isobutyl alcohol could be observed.

C. KIMICH, "*On Derivatives of Methazonic Acid.*" The sodium salt of this lately discovered acid—obtained by treatment of nitro-methane with an alcoholic solution of caustic soda—yields, with diazo-benzene nitrate, azophenyl-methazonic acid,—

$$C_2H_3NaN_2O_3+C_6H_5N_2NO_3=$$
$$=NaNO_3+C_6H_5N_2C_2H_3N_2O_3.$$

The formation is analogous to that of azo-nitro-methylphenyl, and the salts are, like those of the latter, always basic and rich in water of crystallisation. Azo-p aratolyl-methazonic acid is prepared in a similar manner. These two bodies are the first well-defined crystalline derivatives obtained from methazonic acid, and their analyses confirm the formula for it, $C_2H_4N_2O_3$. Reduction of the acid with sodium amalgam yields only ammonia and an amorphous mass.

G. VORTMANN, "*On Ammoniacal Cobalt-Bases.*" The author has obtained a new roseo-cobaltic chloride, $Co_2Cl_6.10NH_3:2H_2O$, by the addition of concentrated hydrochloric acid to a solution of ammonium-cobaltous carbonate, which had been oxidised by the action of the air. The new salt differs from the ordinary roseo-compound in possessing a deep carmine colour, and in yielding with dilute hydrochloric acid a new purpureo-cobaltic chloride, of a pure violet colour, and isomeric with the purpureo-compound already known.

F. VON LEPEL, "*Spectroscopic Detection of Magnesium.*" The author gives the results of a number of experiments on the practicability and sensitiveness of the spectroscopic tests for magnesium with purpurin solutions. The operations required are few in number and the results satisfactory. The presence of large amounts of lime-salts obscures the spectrum, and they must be removed with tartrate of potassium. Magnesium was found in the crystalline substance of the eye, in curds, in the juice of apples and pears, &c., and seems to be most extensively spread in the animal and vegetable kingdoms.

R. SCHIFF, "*On the Constitution of Aldehyd Ammonia and Chloral Ammonia.*" In order to prove whether a hydroxyl group is present in these compounds, chloral ammonia has been submitted to the action of acetyl chloride and acetic anhydride. In both cases a monoacetyl-chloral ammonia is obtained, perfectly identical with the chloral-acetamid obtained from the union of chloral and acetamid. If this compound is treated with acetyl chloride at a high temperature, another acetyl group is introduced, and it is evident that this last group is substituted in a hydroxyl group, on account of the easy decomposition with warm water, &c. These two reactions would lead to the structural formula of—

$$CH_3.C(OH)(NH_2)H$$

for aldehyd ammonia. The author has found that chloral ammonia can easily be prepared in large quantities by leading gaseous ammonia through a solution of chloral in chloroform, until the latter solidifies to a compact white mass.

E. SCHUNCK and H. RŒMER, "*On Purpuroxanthin-Carbonic Acid.*" This substance, $C_{14}H_7COOHO_4$, was found in commercial purpurin. It is separated from purpurin, alizarin, and purpuroxanthin by means of its greater solubility in boiling water, and the slowness with which its alumina compound is decomposed by hydrochloric acid. It is precipitated from the aqueous solution by hydrochloric acid as a voluminous orange-coloured mass. The new acid melts at 231°, and is decomposed at 233° into carbonic acid and purpuroxanthin, from which property it receives its name. No characteristic absorption bands are given by the various solutions.

"*On the Detection of Small Quantities of Alizarin in Purpurin.*" Hitherto this was almost impossible, because the comparatively greater intensity of the absorption phenomena of alkaline purpurin solutions prevented the use of the spectroscope, and the methods of separation are at present too inexact to be applicable for small quantities. The authors find that by exposing a solution of the two substances in caustic soda to the action of the air, the liquid gradually becomes colourless, the purpurin is completely decomposed, and the alizarin—after being released from its sodic compound with HCl—can be dissolved in ether and identified by the spectroscopic reactions. A solution containing 0·00005 grm. alizarin responded to the test.

J. PICCARD, "*On Chrysin, Tecto-chrysin, and Higher Homologues.*" By the action of ethyl iodide in an alcoholic solution of caustic potash upon chrysin, the group CH_3 was introduced into the latter, thus artificially preparing the tecto-chrysin, which accompanies it in poplar buds. Ethyl-chrysin and amyl-chrysin are obtained in analogous ways. The analysis of these compounds show the formula of chrysin to be $C_{15}H_9O_3.OH$.

"*Lecture Experiment upon the Synthesis of Water.*" "*Resorcin-trisulphonic Acid.*" The author has obtained this acid, $C_6H(OH)_2(SO_3H)_3$, by the action of fuming sulphuric acid upon resorcin-disulphonic acid, in sealed tubes at 200°. It is separated in the form of the calcium salt, as the barium salt is nearly as insoluble as $BaSO_4$. The acid itself, obtained from the lead salt with H_2S, is too soluble to be crystallised.

E. SCHMIDT, "*On the Formation of Allyl-iso-sulpho-cyanate.*" Potassium myronate, treated at 0° with a myrosin solution (filtered extract of white mustard), yields allyl-iso-sulpho-cyanate, with small quantities of the isomeric sulpho-cyanate."

"*On Camphor of Cubebs.*" The author's opinion that this is a hydrate of oil of cubebs is strengthened by its decomposition into water and oil of cubebs at ordinary temperature, when left for some time over sulphuric acid.

"*Action of Carbonyl Sulphide upon an Aqueous Solution of Ammonia.*" As in the case of an alcoholic solution of ammonia, ammonium oxy-sulpho-carbamate is formed.—

$$COS + 2NH_3 = H_2N - CO - SNH_4.$$

This suffers gradually the two following decompositions:—

$$COSN_2H_6 = CO(NH_2)_2 + H_2S,$$
$$COSN_2H_6 + H_2O = CO_2 + NH_3 + H_2S.$$

If treated with freshly-prepared hydrate of lead, or carbonate of lead in the cold, the first decomposition is the principal one, and the liquid yields, upon filtration and evaporation, considerable quantities of urea. On account of its ease and rapidity this method of preparing urea is adapted for lecture experiments and the production of small quantities.

"*On the Compounds of Morphine with Hydriodic and Hydrobromic Acids.*" The author finds that the two compounds obtained, one by the action of KI upon morphine acetate, and the other by solution of morphine in HI, hitherto regarded as two different bodies, are in all respects identical. The bromine compound obtained from the solution of morphine in HBr posseses the formula—

$$C_{17}H_{19}NO_3BrH + 2H_2O,$$

and is in its properties analogous to the iodine compound. The same author has found the specific gravity of bromoform at 14·5° to be 2·775.

A. KERN finds, in the course of experiments "*On the Preparation of Mono-Methyl Aniline,*" that aniline and methyl iodide do not yield this body, as stated in most text-books, the reaction being as follows:—

$$3(C_6H_5.NH_2) + 2CH_3I = = C_6H_5.N(CH_3)_2 + 2(C_6H_5.NH_2.HI).$$

E. SCHULZE and J. BARBIERI have found "*Glutamine,*" $C_5H_8NO_3NH_2$, in the young sprouts of gourds, forming 1·75 per cent of the dried substance. It is formed during germination, and appears to perform the same part as asparagin in other germs, viz., providing albumen for the wants of the growing plant.

RUSSIAN CHEMICAL SOCIETY.

N. SOKOLOFFSKY, "*Action of Bromine upon Aceton.*" By the addition of bromine to an aqueous solution of aceton the author forms two liquid substitution-products, mono-brom-aceton and dibrom-aceton. The first has the sp. gr. 1·99, is colourless, possesses strong refractive powers, and a strong penetrating odour attacks the eyes violently, and cannot be distilled alone without decomposition, but is easily carried over with aqueous vapour. Dry ammoniacal gas forms with it an unstable crystalline compound, analogous in composition to aldehyd ammonia. Aqueous ammonia yields several soluble bases. Iodine and ammonia change it into iodoform and acetic acid. Dibrom-aceton has the sp. gr. 2·55 and is less unpleasant. Both bodies yield with acid sodium sulphite characteristic crystalline compounds. The addition compound $C_3H_6OBr_2$ was obtained by the addition of bromine to an aqueous solution of aceton kept constantly at a low temperature. It explodes as soon as freed from the water.

S. PRZIBTEK, "*Synthesis of α Oxybutyric Acid.*" This acid, $CH_3.CH_2.CH.OH.COOH$, is prepared synthetically by the action of hydrocyanic acid and hydrochloric acid upon propyl aldehyd; thus confirming the structural formula of the acid already proposed by Markownikoff.

G. LAWRINOWITSCH, "*On the Pinacon and Pinacolin Derived from Methyl-ethyl-keton.*" See CHEMICAL NEWS, vol. xxxv., p. 53.

J. KANNONIKOFF and A. SAYTZEFF, "*Action of Allyl-iodide and Ethyl-iodide upon Ethyl-formiate.*" These three compounds mixed together and headed with zinc, yield diallyl carbinol.

D. BOBYLEN, "*Theoretical Researches Regarding the Distribution of Static Electricity upon the Surfaces of Conductors Composed of Heterogenous Parts.*"

O. CHWOLSON, "*On Electric Rays.*"

CORRESPONDENCE.

PATENT LAW AMENDMENT.

To the Editor of the Chemical News.

SIR,—Taking an active interest in the Patent Law Amendment, I shall be glad of any practical suggestions bearing upon the proposed bill from chemists and others. May I beg that such may be sent to me as they occur, in as short a compass as may be. As I act only as a private individual I would suggest that duplicates be sent to the Inventors' Institute (of which I am not a member).

The bill proposed last session had so many shortcomings that the importance of thought and action beyond legal circles is too evident to require any demonstration.—I am, &c.,

MARSHALL HALL.

13, Old Square, Lincoln's Inn, W.C.
February 17, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 5, January 29, 1877.

Reply to Dr. Bastian.—M. L. Pasteur.

Germs of Bacteria in Suspension in the Atmosphere and in the Waters.—MM. L. Pasteur and Joubert.—A continuation of the interminable controversy on spontaneous generation.

Researches on the Irisation of Glass.—MM. E. Fremy and Clémandot.—In a former memoir on the aventurine of Venice the authors have shown that it is possible to obtain a glass comparable to that once manufactured in Italy by causing silicate of ferrous oxide to react upon silicate of copper in a vitreous mass, and at a suitable temperature. Under these conditions the silicate of iron passes to the maximum of oxidation, reducing the silicate of copper, and producing in the glass those metallic and brilliant crystals which characteri-

aventurine. Glass, submitted to influences which determine its gradual decomposition, becomes covered with slender laminæ, which produce very remarkable phenomena of irisation. This alteration of glass may be witnessed either upon glasses which have remained under water or in moist ground, or upon the windows of stables exposed to ammoniacal vapours, and especially upon glass objects found in ancient burial places. M. S. Meunier has exhibited a glass iridised under the influence of the acid vapours thrown off by certain volcanic ashes. The authors have attempted to produce in a regular manner this irisation, which gives glass the aspect of pearl or of nacre, and to render it permanently adhesive. After numerous attempts they have succeeded in the most complete manner. Their process consists essentially in submitting the glass, under the influence of heat and pressure, to the action of water containing 15 per cent of hydrochloric acid. Several kinds of glass are suitable for this operation, whilst others are not adapted for it; the chemical composition and the conditions of re-heating and annealing have an influence upon this phenomenon. In the manufacture of ordinary glass, the ease with which it becomes iridescent is a defect. This is especially the case with glass intended for bottles, optical glasses, &c., the resistant power of which may be tested by submitting it to the process devised by the authors.

Report on a Memoir of M. H. Becquerel entitled "Experimental Researches on Rotatory Magnetic Polarisation."—M. Becquerel's paper may be regarded as a continuation of the researches of Faraday on the magnetisation of light.

Products Obtained by the Ignition in Closed Vessels of the Dregs of Beet-root Treacle.—M. Camille Vincent.—Among the products obtained are ammonia, trimethylamin, methylic alcohol, cyanide and sulphide of methyl, hydrocyanic, formic, acetic, propionic, butyric, valerianic, and caproic acids; carbides of iron not examined, phenic acid, a series of oily alkaloids, finally a mixture of hydrogen, protocarbide of hydrogen, carbonic acid, and carbonic oxide.

A New Arrangement of Lightning-Rods.—M. Jarriant.—The author employs hollow rods, and thus obtains an increased conducting surface with less weight.

Effects Produced by the Addition of Foreign Bodies to Carbon in the Preparation of Coke Pencils for the Electric Light.—The addition of certain salts of magnesia and lime, especially bone-earth, was found to increase the light produced, but the flame and smoke accompanying these electro-chemical lights appeared such an obstacle in the way of their utilisation that the experiments were discontinued.

Researches on the Spectra of Metals at the Base of Flames.—M. Gouy.—Reserved for insertion in full.

Preparation of the Alkaline Nitrites.—M. A. Etard.—Equal molecules of a nitrate and of the corresponding sulphide are heated to redness in a crucible. When cold the powdered mass is treated with a small quantity of alcohol, which dissolves out the pure nitrite.

Formation of Natural Sulphur Waters.—M. E. Planchud.—The author, who has experimented on one spring merely, concludes that such waters owe their sulphur to the reduction of various sulphates, effected by the agency of living beings, acting as ferments. Dead organic matter does not suffice.

Reimann's Farber Zeitung.
No. 2, 1877.

With reference to a Parisian contemporary Dr. Reimann writes—"We entirely agree with Prof. Kolbe that chemistry in Germany, instead of searching for facts, is engaged with unfruitful speculation on the position of atoms. But is the case different in France? It is well known that the so-called "new" direction, which now becomes so pernicious, took there its origin."

MEETINGS FOR THE WEEK.

MONDAY, 26th.—London Institution, 5.
—— Medical, 8.
—— Royal Geographical, 8.30.
TUESDAY, 27th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Anthropological Institute, 8
WEDNESDAY, 28th.—Society of Arts, 8. "Middle Class Education in Holland," by John Yeats, LL.D.
THURSDAY, March 1st.—Royal, 8.30.
—— London Institution, 7.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Chemical, 8. "Theory of the Bunsen Flame," by Prof. Thorpe. Experimentally illustrated.
FRIDAY, 2nd.—Royal Institution, 9. "History of Birds," by Prof. Huxley.
—— Society of Arts, 8. (Indian Section). "The Progress of Trade in Central Asia," by Sir Douglas Forsyth, C.B., K.C.S.I.
—— Geologist's Association, 8.
SATURDAY, 3rd.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."
—— Physical, 3.

TO CORRESPONDENTS.

ERRATUM.—In No. 898, p. 65, col. 1, line 11 from bottom, *for* "the carnation" *read* "cloves."

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BOARD OF WORKS FOR THE POPLAR DISTRICT.

APPOINTMENT OF ANALYST.

The Board will, at their meeting to be held at the Offices, on Tuesday, the 13th day of March next, at 6 o'clock p.m., be prepared to receive Applications from duly qualified persons, according to the provisions of the "Sale of Food and Drugs Act, 1875," desirous of being appointed Analyst of this District for a period of One Year at a salary of £100, the minimum number of analyses to be made during the year to be one hundred. Candidates will have due notice when they are required to be in attendance. The Laboratory, with all appliances, has been provided and will be maintained by the Board. Applications, accompanied by not more than two testimonials, addressed to the Board of Works for the Poplar District, 117, High Street, Poplar, endorsed "Application for the Office of Analyst," will be received till 12 at noon of the said 13th day of March next.

The attention of Candidates is particularly called to the 10th Section of the Act, which provides that no person shall be appointed an Analyst of any place who shall be engaged directly or indirectly in any trade or business connected with the Sale of Food or Drugs in such place.

No expenses will be allowed to any Candidate.

WM. HENRY FARNFIELD.
Clerk to the Board.

Offices, 117, High Street, Poplar,
February 19, 1877.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 901.

ON THE

SOLUBILITY OF ETHER IN AQUEOUS HYDROCHLORIC ACID.*

By HARRY NAPIER DRAPER, F.C.S., M.R.I.A.

I AM unable to find that the fact of the considerable solubility of ether in aqueous hydrochloric acid is one generally known. It is not mentioned in any of the more modern works on chemistry, and the only reference to it is, as far as I know, made by Gmelin,† who says—"It"—ether—"likewise dissolves in aqueous hydrochloric acid without producing chloride of ether,"—a statement which is referred to Boullay. The experiments which I have made in this direction will be better understood in the light of a preliminary note on the solubility of ether in other liquids. The following are the results of several independent observations:—In *saturated solution of calcium chloride* ether is apparently quite insoluble. *Distilled water* at 11° C. dissolves, in 100 volumes, 10 volumes of ether. This solubility in water is quite in accordance with results hitherto obtained, but it is customary to state the converse case—*i.e.*, the solubility of water in ether—as 1 in 10, which is much greater than it really is. As the mean result of five experiments I have found that 100 volumes of ether at 12° C. dissolve 2 volumes of water. The error has obviously arisen in the use of ether not absolutely free from alcohol.

The ether employed in my experiments was found to have at 14° C. the density of 0·725, but there is sufficient experimental difficulty in determining the weight of so volatile and expansible a fluid to prevent my attaching any considerable value to this figure. The ether was, however, shaken with finely-divided acetate of rosaniline, and, as this did not communicate the least tint to it, it was concluded that it did not contain *alcohol*. For *water* it was tested by the immersion of bibulous paper saturated with alcoholic cobalt chloride and then dried. This remained blue after twenty-four hours' contact.‡

The aqueous hydrochloric acid was the strongest that I could conveniently work with. It had a specific gravity of 1·196 at 14°, and examined volumetrically was found to contain 38·52 per cent by weight of real acid. Even at this strength it emits dense fumes when exposed to the air.

When equal volumes of the ether and hydrochloric acid just described are mixed together, immediate solution of the ether takes place, the temperature of the mixture at the same time rising considerably. There is also contraction of volume. When 50 volumes of ether and 50 volumes of acid are employed, the resulting solution, when cooled to the temperature which the liquids had before mixing, measures but 95 volumes, and at 14° C. has a specific gravity of 1·010. The solution flows like a thin oil, fumes in the air, is perfectly transparent, and remains so whether cooled to 0° or heated to 38°.

But hydrochloric acid of 38·52 per cent will dissolve much more than its own volume of anhydrous ether. In a very early stage of my experiments it became evident that the quantity which it is capable of taking up bears an inverse ratio to the temperature, and that the volume of ether dissolved is at the ordinary atmospheric pressure constant for any given temperature. The experiments were made with a closely-stoppered graduated tube, in which was added to a known volume of the acid a few volumes more ether than it was able to dissolve at the lowest temperature employed. The mixture was then cooled down to the required temperature and kept at this for an hour, during which time the tube was frequently briskly shaken, and the volume of ether dissolved was then noted. In this way were obtained the results stated in the following table, in which the second and fourth columns give the number of volumes of ether dissolved by 100 volumes of hydrochloric acid, sp. gr. 1·196, at the corresponding temperature in the first and third columns:—

Temperature Centigrade.	Vols. of Ether Dissolved.	Temperature Centigrade.	Vols. of Ether Dissolved.
−16°	185·0	16°	162·5
0°	177·5	21°	157·5
+ 8°	172·5	27°	150·0
9°	170·0	32°	142·5
10°	167·0	38°	135·0

Thus, while at 0° C., 100 volumes of this acid dissolve 177·5 volumes ether; at 38° C. 135 volumes only are dissolved. Or by weight, 100 parts hydrochloric acid dissolve at the lower temperature 107·5 parts ether, and at the higher but 81·8 parts. So that the capacity of hydrochloric acid of this strength for ether is nearly one-third (31·4 per cent) greater at the freezing-point of water than at 38° C. (100° F.) I cannot recal an instance of so great a difference between the relation of solubility to temperature in the case of any two other fluids.

If the solution, saturated at any given temperature, be heated to a temperature higher than this, it at once becomes turbid from the separation of ether, and when the liquid is contained in a thin tube the contact of the warm hand is sufficient to produce in a few seconds complete opacity in a solution which, at the temperature of the laboratory, was quite transparent.

If a sealed tube containing the ether solution and excess of ether, first cooled (say in melting ice), then shaken, and the volume of unabsorbed ether noted, be suspended in a warm room, ether continues to separate in very minute bubbles until the liquid has attained the temperature of the surrounding air. When the tube is once more cooled to 0° without agitation, the liberated ether, being so much lighter than the solution, is not taken up again even after forty-eight hours, but on the tube being briskly shaken it is at once dissolved.

The increase of temperature at the moment of solution is considerable, being, with 10 c.c. of acid and 17 c.c. of ether, from 11° to 35° (*i.e.*, 22·5° C.).

No chemical combination takes place: the ether is simply dissolved by the acid, and can be separated by simple dilution with water. Thus 5 volumes of a solution (= 3 volumes ether) gave, on addition of 5 volumes of water, 2 volumes ether. By distillation nearly all the ether may be recovered. Two experiments were made in this direction, and in each case 17 c.c. ether were obtained from a solution which—calculating from the temperature at which it was saturated—contained 19 c.c.

The solvent power of aqueous hydrochloric acid for ether is directly proportional to the strength of the acid. Thus the acid of 38·52 per cent, which I have used in my experiments, dissolves at 10° C., in 100 volumes, 167 vols. of ether, while the acid of the British Pharmacopœia, containing 31·8 per cent HCl, dissolves at the same temperature but 125 volumes.

It should be noted that absolute ether dissolves hydrochloric acid from the aqueous acid. The acid of 38·52 per cent was agitated for some time with excess of ether, the temperature being 12° C. The supernatant ether was then removed with a pipette, and its contain- determined by an alcoholic solution of silve was found to contain chlorine equal to 2·40 real hydrochloric acid.

* Read at the Meeting of the Pharmaceutical Society of Ireland, February 8, 187.

† "Handbook," vol. viii., p. 190.

‡ Much of the "anhydrous" ether of commerce reddens cobalt paper at once, and is itself very soon tinged by the rosaniline salt.

ON RUSSIAN PLATINUM-ORE FROM THE OURAL MOUNTAINS.

By SERGIUS KERN, St. Petersburg.

Considerable quantities of platinum-ore are every year mined in Nishni-Tagil and Goroblagodatsky districts on the Oural Mountains. The platinum-ore of these districts contains notable quantities of foreign metals of the platinum group, except ruthenium, which is only in traces found in these ores. The analyses of some newly found platinum-ores near the districts mentioned above may be of some interest to chemists studying the properties of the compounds of rare metals of the platinum group, as the ore is sold at the Mint in St. Petersburg at a very moderate price.

Analyses of Platinum-Ores.

1. *Goroblagodatsky District. Samples.*

	No. I.	No. II.	No. III.
Platinum	87·50	84·50	80·05
Rhodium	1·20	2·90	1·05
Iridium	0·05	0·90	2·50
Osmium	0·01	0·60	traces
Palladium	1·05	0·05	2·03
Iron	8·60	7·55	11·04
Copper	0·65	0·60	1·02
Osm-iridium	1·50	2·80	2·51
Total	100·56	99·90	100·20

2. *Nishni-Tagil District. Samples.*

	No. I.	No. II.	No. III.
Platinum	80·87	71·20	89·05
Rhodium	4·44	1·50	4·60
Iridium	0·06	2·40	traces
Osmium	traces	0·05	traces
Palladium	1·30	1·95	2·35
Iron	10·82	13·40	3·40
Copper	2·30	6·70	0·59
Osm-iridium	0·11	2·65	traces
Total	99·90	99·85	99·99

Nearly all the platinum-ore obtained in Russia is sent abroad, because in this country there are no refineries of platinum-ore. A year ago a small platinum refinery commenced to work on a small scale in Petersburg, but the production of platinum articles is, as it seems to be, very limited. It is a curious fact that platinum sold abroad in a raw state at a very moderate price returns back to Russia in ready chemical articles of a very high price. Thus platinum crucibles are sold by weight at a price of 5s. 6d. for every 4 grms. of platinum; 1 drm. of platinum chloride 2s. 6d. Many Russian chemists prefer the use of French platinum crucibles, which are said to be more durable, and more cleanly prepared than English crucibles. My opinion is that English crucibles stand heat far better than any kind of crucibles. I have had in my hands for about two years several platinum crucibles brought from London, and they are all now in a workable state. The presence of copper in these crucibles was found as traces, and only in one out of five crucibles 0·002 per cent of iron was present. The following two analyses of a pair of crucibles brought from Paris shows the quality of the metal:—

No. I.

	Per cent.
Platinum	98·70
Iridium	0·56
Iron	0·30
Copper	0·22
Total	99·78

No. II.

Platinum	97·90
Iridium	1·45
Copper	0·67
Total	100·02

Of course many French works give very handsome platinum crucibles, but, on the other hand, English manufacturers send to the trade chemical apparatus prepared very carefully from pure platinum and of a very high quality, so that it is difficult to understand why in Russia English platinum crucibles are not in favour.

Obouchoff Steel Works, St. Petersburg.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A W. HOFMANN.

(Continued from p. 68.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

The before-mentioned plate-furnaces give in most cases very satisfatory results.

At Oker in the Harz a plate-furnace was built for hammer dust, poor in copper but rich in sulphur, such as the Rammelsberg yields in quantity. The operations carried on were changed in the meantime, and when the structure was complete it was no longer found desirable to burn the ores in the plate-furnace for which it was intended. It was charged with ores rich in copper, the burning was not satisfactory, and the furnace was removed.

Hitherto only one plate-furnace has been built behind each kiln for lump pyrites instead of arranging a system of plates above each compartment of the kiln as in Perret's furnace.

For the utilisation of the hammer dust from lump pyrites a tower suffices as given in detail in the plans published, capable of burning every twenty-four hours 600 to 1000 kilos. of ore, the granules being from 1 to 12 millimetres in diameter. Other combinations would permit a richer charge, and such will doubtless be built.

The construction described in the journal above cited (1872, p. 505) will be further considered when we treat of roasting blende. This furnace requires the maintenance of a separate fire to keep up the heat, and is only to be recommended where coal and smalls are cheap.

Experienced technologists have proposed furnaces with inclined plates, in which smalls may be burnt without the action of lump pyrites and without especial firing, as in the furnace of Maletras. Where rich pyrites are accessible such arrangements may prove advantageous, but we have no experience as to their action.

Determination of Sulphur in Pyrites.—The determination of the sulphur in the burnt ores is generally effected as follows:—The finely powdered ore is heated in a flask with a mixture of 2 parts nitric acid and 1 part hydrochloric, evaporated to dryness, and again treated with hydrochloric acid to expel any nitric acid. The sulphates are then dissolved by treating the residue with hydrochloric acid and water, filtered, and the sulphuric acid in the filtrate is determined by means of chloride of barium. Chemists have made many attempts to place a more expeditious method in the hands of the manufacturer.

In 1861, Pelouze† published a process in which the ores are treated with chlorate of potassa and a weighed quantity of pure carbonate of soda in a platinum crucible.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† Pelouze, *Ann. Chim. Phys.*, 3, 63.

The melted mass is dissolved in water, and the excess of soda is determined volumetrically by saturation with a standard acid. Barreswill called attention to a source of error in this process in case of the presence of arsenical compounds in the ore. Bottomley and Bocheroff also pointed out its inaccuracy. J. Kolb* made some interesting comparative experiments between the determination of sulphur by the above-mentioned gravimetric process and the volumetric method of Pelouze. The results differed by several per cents. Kolb found that the source of error consisted, on the one hand, in the formation of silicate of soda, and, on the other, in the decomposition of chlorate of potassa in presence of oxide of iron into chlorine, oxygen, and caustic potassa. Kolb proposes to fuse the finely powdered ore along with 5 grms. soda and 50 grms. oxide of copper at a dull red heat; to treat the melted mass with hot water, to filter, and determine the excess of soda in the filtrate volumetrically.

In the Freiberg works† 1 grm. of finely ground ore is mixed with 3 grms. anhydrous carbonate of soda and an equal weight of saltpetre. This mixture is placed in an iron crucible melted in a muffle at a red heat, the mass is dissolved in hot water, and the liquid is filtered into a beaker, in which there is a little hydrochloric acid to saturate the excess of soda. The liquid, which should have an acid reaction is then boiled for a short time, and the sulphuric acid is determined volumetrically with a solution of chloride of barium, standardised so that 1 c.c. indicates 2 per cent of sulphur.

Utilisation of Burnt Ores.—In the French department of the Vienna Exhibition the Chemical Works of the company St. Gobain, Chauny, and Cirey, displayed iron obtained from non-cupriferous burnt pyrites. The thorough roasting of the pyrites, which makes it capable of being worked for iron, is said to have been effected by allowing the smalls to cool in thin layers, and roasting them repeatedly in Perret's furnace. The burning was effected by charging the plates alternately with burnt and with green ore. The hot gases evolved from the green smalls play over the plates charged with burnt ore and effect a second roasting.

In 1859, List pointed out the existence of zinc in the iron pyrites of the "Sicilia" mine.‡ P. W. Hofmann ascertained that this zinc is present in the burnt ore in the state of sulphate, and extracted it by systematic lixiviation.§ The solution thus obtained, sp. gr. 1·25, consists almost entirely of sulphate of zinc along with a little copperas. It is heated to about 40° and mixed with common salt in equivalent quantity. Thus there is produced a solution of sp. gr. 1·38, which, on cooling, deposits sulphate of soda in sufficient quantity to cover all expenses. The mother-liquor is concentrated to 1·60 sp. gr., and the chloride of zinc thus obtained, containing mere traces of sulphates and of iron, is sold either in the liquid or the solid form. According to P. W. Hofmann's account large quantities of zinc chloride are thus obtained at Wocklum, from the sulphur ores of the "Sicilia."

Richters‖ shows to what extent and under what circumstances the smelting of ores so rich in sulphur as are burnt pyrites in Germany could, from a chemical point of view, prove successful. In fact, many attempts have been made to utilise the burnt ores for the production of crude iron, but none of the methods proposed has found acceptance. In England the burnt Spanish, Portuguese, and some of the Norwegian pyrites are used after roasting. Wedding and Ulrich have carefully studied and described the treatment of burnt ores in England.¶

The burnt ore is sold by the chemical works to copper smelters with an average percentage of 3·66 sulphur, 58·25 iron, and 4·14 copper. It is first ground, then mixed with 15 to 20 per cent of salt, and submitted to a chlorinised roasting in reverberatories or muffle furnaces. The gases evolved are condensed in a coke tower through which water flows, thus furnishing a mixture of hydrochloric and sulphuric acid. The copper is converted by roasting into a soluble chloride, which is extracted first with water and then with the acid mixture from the condensation tower. The copper is then precipitated by iron. After nine successive lixiviations the residue contains merely from 0·08 to 0·2 per cent of copper, and 0·16 to 0·25 of sulphur, and is smelted for iron in blast-furnaces as "purple-ore." A part is also used in lining the puddling furnaces, and another small portion is reduced with coal to the state of spongy iron, and then serves to precipitate metallic copper from its solutions.

Claudet* patented a process in England for recovering the silver which is dissolved in the saline liquors as silver chloride by precipitation with iodide of potassium. His process is even applicable to ores containing merely 0·027 per cent of silver. The liquors formed by extracting the roasted ores with water contain 95 per cent of all the silver present; from these liquors the silver is precipitated to the extent of about 11·6 grms. per ton of ore. The net profit amounts to two shillings per ton of ore, giving at the Widnes copper works a yearly return of £3000.

When coal in Lancashire cost 5s. per ton, Phillips,† after extracting the copper, precipitated the iron, and obtained fine sulphate of soda by evaporating the mother-liquor. At the present price of coal this process has been abandoned.

The chemical works of Aussig and Griesheim exhibited at Vienna large quantities of thallium. This metal is obtained from the flue dust formed on burning pyrites, deposited between the kilns and the chambers. Max Schaffner‡ describes the process employed at Aussig. The flue dustis repeatedly boiled in water acidulated with sulphuric acid, and from the filtered solution the metal is precipitated on the addition of hydrochloric acid as impure thallous chloride. The precipitate is washed with cold water and converted into sulphate by heating with concentrated sulphuric acid. The sulphate is then dissolved in water and again mixed with hydrochloric acid, which precipitates tolerably pure thallous chloride. This is again treated with sulphuric acid and the sulphate is reduced with pure metallic zinc. The metallic sponge thus obtained is washed with well-boiled water, dried between blotting-paper, and melted over the lamp in a porcelain crucible, into which a stream of coal-gas or of hydrogen is conducted.

To be continued.)

* J. Kolb, "Notes sur l'essai des Pyrites," 1869.
† Schwarzenberg, *opus citat.*, p. 424.
‡ List, *Tech. Chem. Mittheilungen.* Hague, 1859.
§ P. W. Hofmann, private communication.
‖ Richters, *Dingle* cxcix., 292.
¶ Wedding and Ulrich *Zeitschr. Berg. Hutten. u. Salinen w.*, xix., 292.

SCHEELE'S GREEN: ITS COMPOSITION AS USUALLY PREPARED AND SOME EXPERIMENTS UPON ARSENITE OF COPPER.§

By S. P. SHARPLES, S.B.

In 1778, the eminent Swedish chemist, Charles William Scheele, communicated to the Academy of Sciences at Stockholm the method of preparing the green pigment which has since borne his name. He, however, says, that it was discovered three years previously.

This pigment is of a yellowish green colour, and has been long used in the arts under various names; such as mountain green, mineral green, and Swedish green. At the time of its discovery it was the most brilliant green obtainable.

The discovery, in 1814, of the copper aceto-arsenite,

* Claudet, Chem. News, 1871, 184.
† Private communication.
‡ Schaffner, *Sitzb. d. k. Akad. d. Wissenschaft.*, 53, Feb.; *Wagner Jahresbericht*, 1871, 1.
§ Read before the American Academy of Arts and Sciences.

known as Schweinfurth green, Paris green, English green, and sometimes wrongly called Scheele's green, has, however, almost entirely thrown Scheele's green out of the market; and it is at the present day an unknown substance, so far as its use as a pigment is concerned; although it may be still found on the price lists of manufacturing chemists, and the receipts for its manufacture are found in works on dyeing and calico-printing. But its covering power is very low, and it is far inferior in brilliancy to its successful rival, Paris green.

Having had occasion to examine some samples of this pigment some time ago, I became convinced that the composition of Scheele's green, as laid down in the books, was altogether a matter of conjecture, since I could find no record of any analysis that had ever been made of the substance prepared according to Scheele's directions, which have been copied without change for the last hundred years.

The formula given varies with the date; Scheele himself, of course, neither made a quantitative analysis nor gave a formula. Succeeding writers seem to have followed him in the first respect, but have given formulæ to correspond with their ideas of the composition that the salt should have.

The older writers give the formula $CuOAs_2O_3$; this would give the percentages of copper oxide and arsenic trioxide, as follows:—

Copper oxide	29·50
Arsenic trioxide	70·50
	100·00

(The atomic weights used through this paper are: oxygen, 16; copper, 63·4; the old formulæ being changed to correspond to these weights. As a matter of convenience, I have made all statements of composition in terms of copper oxide and arsenic trioxide, but in so doing I have no wish to be understood as asserting that they exist as copper oxide and arsenic trioxide in the compound.)

Berzelius* gives the formula, $\dot{C}u_2\ddot{A}s$; this in modern notation, would be $Cu_2As_2O_5$; or in percentages,

Copper oxide	44·50
Arsenic trioxide	55·50
	100·00

He describes the methods by which it may be obtained as either, by digesting carbonate of copper with water and arsenious acid, or by Scheele's method, giving for the latter almost exactly Scheele's receipt.

Ure† gives Scheele's receipt, and then says it consists of oxide of copper, 28·51, arsenious acid, 71·46. This corresponds to the first formula given above, $CuAs_2O_4$.

Miller‡ gives the formula $CuHAsO_3$. This in percentages would be:—

Copper oxide	42·37
Arsenic trioxide	52·83
Water	4·80

This formula seems to be the favourite one at present, and may be found in most of the text-books.

Bloxam,§ in the course of his long and elaborate investigations of the arsenites, made some experiments upon copper arsenite, but failed to obtain a definite compound. The first salt made, he says, contained:—

	Per cents.	Equivalents.
Copper oxide	40·54	1·88
Arsenic trioxide	53·80	1·00
Water	5·67	1·16

The second contained:—

	Per cents.	Equivalents.
Copper oxide	44·29	2·21
Arsenic trioxide	49·98	1·00
Water	5·73	1·26

The third product gave:—

	Per cents.	Equivalents.
Copper oxide	46·52	2·35
Arsenic trioxide	49·36	1·00
Water	4·12	0·92

The fourth gave:—

	Per cents.	Equivalents.
Copper oxide	42·69	1·96
Arsenic trioxide	52·67	1·00
Water	4·64	0·97

From this last analysis he deduces the formula $CuHAsO_3$. In a foot-note he says: "Scheele's prescription for the commercial green arsenite of copper involves 2·3 equivalents of oxide of copper for one equivalent of arsenious acid, so that Scheele's green dried at 212° F., appears to be essentially a mixture of $CuHAsO_3$, with an excess of oxide of copper."

This observation is perfectly correct if nothing is taken into the account except the quantities taken by Scheele; but Scheele himself says, in a foot-note:* "The water with which the colour is lixiviated contains a little arsenic, and must not be thrown out in a place to which cattle have access." The evident tendency of this loss of arsenic would be to make the salt more basic than the formula $(CuO)_{2·32}As_2O_3(H_2O)_{92}$ calls for, this being the formula which Bloxam supposes to represent Scheele's green.

In Watts's "Dictionary,† under the head of arsenite of copper, this sentence occurs: "It is a light green precipitate, which dissolves in an excess of ammonia, without colour, yielding a solution of arsenic acid and cuprous oxide."

Berzelius's formula is given, and the sentence just quoted is evidently a translation, either directly or indirectly, from the same author.

The description of copper arsenite in the French edition of Berzelius, Paris, 1847, is as follows: "The neutral salt is obtained by precipitating sulphate of copper by arsenite of potassa. The precipitate is green. When it contains an excess of base, its colour is more intense; but it decomposes spontaneously, in a little time becoming a dark brown, and then contains cupric arsenate and cuprous arsenite. Caustic ammonia dissolves this salt into a colourless liquid containing, probably, cuprous arsenate." The German of 1838 is the same as the above, with the exception that it reads: "When the alkali is in excess, the colour is more intense, but it decomposes in a little time," &c. "This salt" referred to in the above paragraph, is evidently the brown salt and not the green. Moreover, the German text, and not the French, is the correct one, as is shown by my own experiments.

In this connection, the following extract is of interest. Rose says of Scheele's green: "This precipitate is soluble in an excess of ammonia, also in an excess of hydrate of potassa. The solution has in both cases a similar blue colour. The blue solution formed by hydrate of potassa deposits in time reddish brown suboxide of copper; the liquid becomes colourless, and contains arsenate of potassium. The blue solution formed by ammonia is not modified by time."

The reference from Berzelius seems to have been misunderstood by German as well as by English writers, as the same statement occurs in the *Handwörterbuch der Chemie*, B. 2, 1858, p. 300, which says Scheele's green dissolves colourless in ammonia as arsenic acid and cuprous oxide. Graham-Otto‡ also repeats the same.

In the New Chemistry,§ the above blunder is repeated, and two formulæ are given, as follows: "Arsenite of copper, $(Cu_2O)_2As_2O_3$ or $Cu_3(AsO_3)_2$." And the article finishes by saying there are also two hydrated salts, $CuH_4(AsO_3)_2$, and $CuHAsO_3$. The percentage composi-

* "Ure's Dict.," New York, 1847, p. 1100.
† "Traité de Chémie," Tome 4, p. 182. Paris, 1847.
‡ Miller's "Elements of Chemistry." London, 1864, p. 292.
§ Bloxam, C. L., *Journ. Chem. Soc.*, 1862, p. 292.

* "Scheele's Essays." London, 1786, p. 254.
† Vol. i., p. 376.
‡ Vol. iii., 557, 4th ed.
§ "Chemistry, Theoretical and Practical." Lippincott and Co.; Phila., 1876, p. 260.

tion of these salts would be as follows, supposing the above formulæ are correctly given :—

	$(Cu_2O)_2As_2O_3$.	$Cu_3(AsO_3)_2$.	$CuH_4(AsO_3)_2$.	$CuHAsO_3$
Copper oxide (sub. 59·06)	54·61	25·33	42·37	
Arsenic trioxide	40·94	45·39	63·18	52·83
Water	—	—	11·49	4·80

In the first of these formulæ there is an evident mistake; it is a copy of the formula given by Watts, without taking into account that Watts, while doubling the atomic weight of oxygen, retained the old weight of copper, so that, corrected, this formula reads $(CuO)_2As_2O_3$; or, in other words, is Berzelius's formula.

But both of the formulæ, one and two, are wrong, from the fact that they contain no water. No. 3 is an evident attempt to represent the acid arsenite which Berzelius mentions, and No. 4 is Bloxam's formula.

As will be seen, the whole literature of the subject is founded upon three sets of facts. Scheele's prescription, which all the authors whom I have quoted have given, making only such alterations as were necessary on account of changes in weights and measures. And it is a singular fact, that not one of these authors has taken the trouble to see if the quantities of copper sulphate and arsenic trioxide taken would produce a salt of the formula given; or have discovered the fact that nearly twice as much potassium carbonate is used as is necessary to saturate the sulphuric trioxide of the copper sulphate, and Scheele's foot-note has been totally ignored.

Secondly, Berzelius's account of the salt, which has evidently been misunderstood.

Thirdly, Bloxam's analyses of salts, which he would have found difficult, if not impossible, to reproduce had he been so inclined.

After comparing the various works cited, it became a matter of interest to find out, in the first place, what Scheele's green really is, what are its properties, and whether there is more than one copper arsenite.

The experiment was tried of making copper arsenite according to the method given by Berzelius; that is, by dissolving copper carbonate in an aqueous solution of arsenic trioxide.

Hydrocopper carbonate was prepared by precipitating copper sulphate in the cold by an excess of sodium carbonate, and washing the precipitate with cold water until free from sulphates. Some of the precipitate was boiled with a saturated solution of arsenic trioxide, its blue colour soon changed to a bright green, which it maintained, although boiled for upwards of an hour. The green precipitate was filtered off, and washed with hot water, until the wash waters were free from arsenic.

The substance remaining on the filter was of a bright green colour, scarcely inferior to Schweinfurth green in brilliancy, although of a yellowish shade.

The green precipitate was dried and analysed; it gave:—

ANALYSIS No. I.

	Per cents.	Atomic Ratios.
Copper oxide	66·02	8·31
Arsenic trioxide..	8·32	0·42
Carbon dioxide..	15·26	3·47
Water..	10·33	5·74
	99·93	

This corresponds well with a mixture of dibasic carbonate and tribasic arsenite.

The brown basic carbonate produced by boiling the hydrocopper carbonate with water was then boiled with arsenic trioxide, but was not changed in colour. The filtrate from the green precipitate contained a large amount of arsenic, but was free from copper, and I failed to obtain on evaporation the yellowish green acid salt spoken of by Berzelius.

Further experiments on the carbonate were tried to see if it could be completely decomposed by boiling with excess of arsenic trioxide, but they all resulted in failure.

It seems to me that Berzelius must have been misled by the production of the brilliant green arsenio-carbonate, as he gives no analysis to support his assertion.

Arsenic trioxide seems to have a very strong influence in preventing the blackening of copper carbonates and hydrates, a very small percentage preventing this well-known reaction.

A series of experiments were then tried on the production of Scheele's green, following the course laid down in the books and by Scheele himself; viz., first, the production of a more or less basic, sodium or potassium arsenite; and, secondly, the addition of this to a solution of copper sulphate.

Experiment No. 1.

	Parts.	Atomic Ratios.
Copper sulphate, $CuSO_45H_2O$ ..	50	2·04
Potassium carbonate, K_2CO_3 ..	25	1·81
Arsenic trioxide, As_2O_3	10	0·50

Dissolved the potassium carbonate in water, boiled and added the arsenic trioxide, filtered and added to the boiling solution of copper sulphate. The precipitate, when washed and dried, was of a yellowish green; the filtrate was blue.

ANALYSIS No. II.

	Per cents.	Atomic Ratios.
Copper oxide	56·98	7·18
Arsenic trioxide..	21·45	1·08
Sulphur trioxide	12·80	1·60
Ferrous oxide	1·60	0·22
Water..	7·17	3·98

Experiment No. 2.

	Parts.	Atomic Ratios
Copper sulphate, $CuSO_45H_2O$ ..	50	2·04
Potassium carbonate, K_2CO_3 ..	30	2·17
Arsenic trioxide, As_2O_3	15	0·76

Treated as before; filtrate, pale blue; precipitate, a brighter green than No. 1.

ANALYSIS No. III.

	Per cents.	Atomic Ratios.
Copper oxide	49·58	6·24
Arsenic trioxide	32·12	1·62
Sulphur trioxide	4·42	0·55
Water..	13·88	7·82

Experiment No. 3.

	Parts.	Atomic Ratios.
$CuSO_45H_2O$	50	2·04
K_2CO_3	40	2·90
As_2O_3	10	0·50

Treated as before; filtrate, pale yellow; precipitate had more of a yellowish tinge than before.

ANALYSIS No. IV.

	Per cents.	Atomic Ratios.
Copper oxide	51·26	6·43
Arsenic trioxide..	31·67	1·60
Sulphur trioxide	5·32	0·66
Water..	11·75	6·53

Experiment No. 4.

	Parts.	Atomic Ratios.
$CuSO_45H_2O$	50	2·04
K_2CO_3	50	3·61
As_2O_3	18	0·90

The potash and arsenic were dissolved and allowed to cool, then added to the cold solution of copper. The mixture effervesced strongly; half of it was allowed to stand until next day, then filtered; the other half was boiled, which operation it stood without blackening. Analysis of the first half gave—

ANALYSIS No. V.

	Per cents.	Atomic Ratios.
Copper oxide	49·55	6·24
Arsenic trioxide..	38·90	1·96
Water..	11·55	6·42

The second half gave—

ANALYSIS No. VI.

	Per cents.	Atomic Ratios.
Copper oxide	46·65	5·87
Arsenic trioxide..	42·94	2·17
Water..	10·41	5·78

This preparation was repeated, using the same proportions; the precipitate was boiled, and washed with hot water until the filtrate was free from arsenic.

ANALYSIS No. VII.

	Per cents.	Atomic Ratios.
Copper oxide	51·40	6·47
Arsenic trioxide..	39·57	1·99
Water..	8·72	4·85

This seems to indicate that either the salt is decomposed by washing with hot water, or that it consists of a strongly basic salt mixed with free arsenious acid. The first view is most likely the correct one, if we modify it so as to read: "it is decomposed by washing with either hot or cold water, forming a more basic salt."

But further experiments seem to show that this decomposition is much slower with cold than with hot water. And I have found it utterly impossible to remove the whole of the arsenic by prolonged washing.

This fact was further confirmed by an experiment of Prof. J. M. Ordway, who washed a portion of the salt with 3000 times its weight of water, without completely decomposing it. The basic salt produced by washing does not blacken on boiling with water, thus showing that we have a true basic salt or mixtures of several basic salts, and not a mixture of Bloxam's normal arsenite, $HCuAsO_4$, and hydrate of copper.

Experiment No. 5.

In order to see if the salt $HCuAsO_4$ could be prepared by taking the exact amount of arsenic trioxide and copper sulphate necessary to form it, the following proportions were taken:—

	Parts.	Atomic Ratios.
Copper sulphate	124·8	2
Arsenic trioxide	49·5	1
Sodium carbonate..	53·0	2

The solution of arsenic in the sodium carbonate was boiled, and added, while boiling, to the solution of copper sulphate. And the ebullition was continued till all the carbonic acid was driven off. The precipitate was washed by decantation once or twice, and then divided into three portions; the first was merely drained, the second was washed a little, and the third was washed until arsenic ceased to be found in the wash-water. These portions were numbered respectively, VIII., IX., X. They all contained basic copper sulphate, and No. VIII. probably contained a little sodium sulphate.

ANALYSIS No. VIII.

	Per cents.	Atomic Ratios.
Copper oxide	49·78	6·27
Arsenic trioxide..	35·93	1·80
Sulphur trioxide	6·07	0·76
Water..	7·56	4·20
	99·34	

ANALYSIS No. IX.

	Per cents.	Atomic Ratios.
Copper oxide	47·71	6·00
Arsenic oxide	43·74	2·21
Sulphur trioxide	3·10	0·39
Water..	5·47	3·04
	100·02	

ANALYSIS No. X.

	Per cents.	Atomic Ratios.
Copper oxide	57·77	7·27
Arsenic oxide	27·50	1·39
Sulphur trioxide	5·27	0·66
Water..	8·97	4·98
	99·51	

None of the above blackened on boiling with water, and all gave a blue solution with ammonia. Nos. VIII., IX. closely approximate a mixture of tribasic sulphate with Bloxam's salt; while No. X. is more basic than the formula for triarsenite calls for.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, January 25th, 1876.

The PRESIDENT in the Chair.

THE following paper was read by the Secretary:—

"*On the Retardation of Chemical Reactions by Indifferent Matters, Especially Glycerin*," by Dr. G. LUNGE.

The observations described below were occasioned by a number of experiments made on behalf of the Swiss Government, for the purpose of discovering a more reliable method of "obliterating" postage stamps than those hitherto in use. Among the stamping inks I prepared with that intention, there were several with a basis of glycerin, and I soon observed that, if any acids were present in such mixtures, they comported themselves differently to colouring matters than if the same acids were used merely in dilution with water. This led me to make some experiments of a simpler nature, and, although I have been prevented by want of time from following them up very far, and from extending them to that point which a true scientific treatment would require, I venture to lay them in that incomplete state before this Society, in the hope that they may not be found quite uninteresting, and that perhaps some one else will take the matter up with more leisure than I have had at my command.

My principal experiments were made upon the behaviour of wrought-iron (in the shape of wire nails) toward a mixture of glycerin and a hydrochloric acid. The hydrochloric acid contained 26·1 per cent of real HCl, and was mixed with an equal volume of pure, syrupy, glycerin. Check experiments were always made with the same hydrochloric acid, mixed with the same volume of water. Fuming hydrochloric acid can be mixed with glycerin easily in every proportion; nor does it act upon the latter chemically, at least, not at the ordinary temperature, at which all my experiments were performed. Although the formation of monochlorhydrin would seem to be excluded by the very conditions of the experiment, I made sure of it by titrating the mixture before use, and, as may be imagined, I found its percentage of HCl exactly as calculated from the dilution, just as if the diluting fluid had been water instead of glycerin. The acid diluted with glycerin in many cases behaves precisely like that diluted with water; for instance, towards sodium carbonate, calcium carbonate, silver nitrate, sodium hyposulphite solution of chloride of lime, litmus, &c.; at least, no difference could be noted in the preliminary tests, and it thus seemed unnecessary to make quantitative trials. A difference was, however, noted in the case of paper stained blue by ultramarine. Whilst a strip of it in the acid diluted with water is beginning to be bleached ten seconds after immersion, and has become perfectly white in thirty seconds, another strip, dipped in the acid diluted with glycerin, only begins to be bleached after the lapse o

forty-five seconds, and is only thoroughly whitened in four minutes.

The difference is, however, much more decisive in the action of the two acids upon iron or zinc. A bright wire nail (weighing 0·4927 grm.) completely dissolved in 6 c.c. of the acid diluted with water in ten hours' time, apart from a small carbonaceous residue. On the other hand, a nail (weighing 0·4875 grm.) immersed in 6 c.c. of the acid diluted with glycerin, weighed—

After 24 hours, 0·4200 = 86·2 p. c. of the original weight.
" 3 days, 0·2764 = 56·6 " " "
" 6 " 0·1405 = 28·8 " " "
" 14 " 0·0065 = 1·3 " " "

The solution still contained free acid, and behaved in every respect like an ordinary acid solution of ferrous chloride; for instance, towards precipitating reagents.

In another experiment, there were immersed:—

(*a*). A nail weighing 0·385 grm. in 20 c.c. of acid diluted with water.

(*b*). A nail weighing 0·450 grm. in 20 c.c. of acid diluted with glycerin.

The evolution of gas (similarly to the previous cases) was much stronger in the case *a* than in the case *b*. After the lapse of three hours both test-tubes containing the iron and acid mixtures were closed by gas delivery tubes, and coanected with graduated cylinders inverted over a pneumatic trough. Eighteen hours later there had been collected from the tube *a* 74 c.c. of hydrogen gas, whilst the iron in it was completely dissolved. The experiment *b* was interrupted forty-four hours after the connection with the graduated cylinder, when only 52 c.c. of gas had been collected, and more than half of the nail was still left undissolved.

The action of the two acids on graduated zinc was much more rapid, but still showed a marked difference. 1 grm. of zinc, with 20 c.c. of acid and water, evolved 200 c.c. of gas in one and a half minutes; 1 grm. of zinc with 20 c.c. of acid and glycerin took eight minutes to produce the same result. Other experiments, always with a similar result, were made with iron borings and hydrochloric acid; also with iron borings and sulphuric acid, diluted in one case with four volumes of water, in the other with four volumes of glycerin.

The cause of the retardation of the action upon metals in the case of acids diluted with glycerin can hardly be a purely chemical one, since, on the one hand, the glycerin is not acted upon, and since, on the other hand, it does not itself act either upon the reagents or upon the product of the reaction. The latter (ferrous chloride) is easily soluble in glycerin, as was proved by independent experiments, and it cannot, therefore, be presumed that the case is analogous to the insolubility of some metals in concentrated acids. Probably the real cause is—at least, partly—the viscosity of the glycerin, which is perfectly apparent even in the mixture with acids. The gas bubbles cannot liberate themselves very quickly from the iron, and thus prevent the contact between it and the acid. This assumption is supported by the fact, that the attack of acid upon iron is much more weakened by dilution with a solution of gum arabic than with pure water, as I found on trying it. But this explanation does not hold good for the retardation of the action of hydrochloric acid upon ultramarine, as well as in several other cases observed by me, and the following experiments do not in any way seem to be compatible with it. If fuming hydrochloric acid, diluted with the same bulk of water, be mixed with a little lamp-black (moistened with a drop of alcohol, to make the acid wet it) and if iron nails are immersed in the mixture, they are so little acted upon, that the evolution of gas is hardly perceptible at all; twenty-four hours after the nail looks exactly as it did at first. But if the mixture be now thrown upon a filter, and the same nail be placed in the acid running through the filtering paper, a strong evolution of gas commences immediately, and the nail is dissolved very soon.

The following quantitative experiments were made with a mixture of 50 parts of glycerin with 30 parts of fuming hydrochloric acid, and 3 parts of lamp-black. A nail weighing 0·536 grm. produced only after some hours a few minute bubbles of gas, and showed the following weights:—

After 3 days, 0·4780 = 89·2 p. c. of the original weight.
" 6 " 0·4001 = 74·6 " " "
" 14 " 0·2575 = 49·0 " " "

In another experiment, a nail of 0·5766 grm. weighed—

After 3 days, 6·5124 = 88·8 p. c. of the original weight.
" 6 " 0·4440 = 77·0 " " "

The experiment was then interrupted by filtering the mixture. In the filtrate, 92 per cent of the acid could be proved analytically; the remaining 8 per cent might easily have been lost by incomplete washing of the slimy carbonaceous residue; but in any case there was far more acid in the filtrate than sufficient for dissolving the nail, and, in fact, the same placed in the filtrate at once caused an evolution of gas, certainly only at a moderate rate, as explicable by the presence of glycerin, and by the large dilution with the washing-water. Zinc behave in exactly the same way towards the same mixture.

It does not seem impossible that this retarding action of indifferent substances may find a useful application, both for moderating chemical reactions in scientific operations, and in technical operations on the large scale. It would give me great pleasure if this subject were pursued further by one interested in it, and if a satisfactory explanation of that phenomenon were suggested.

NOTICES OF BOOKS.

Jahresbericht über die Fortschritte aus dem Gebiete der reinen Chemie. By Dr. W. STAEDEL. Tübingen: H. Laupp.

THE knowledge of the German language is now so common among English chemists that many German publications have an extensive circulation in this country. And great difficulty is experienced in acquiring information on special points, owing to the great numbers of the journals in which memoirs are published, and to the various languages in which they are written. This want has been felt, and attempts have been made to rectify it, by the abstracts of chemical papers published in the *Journal* of our own Chemical Society, and also in the list of titles at the end of the *Berichte* of the German Chemical Society. The *Jahresbericht der Chemie*, which had for its object not merely to furnish references, but also to give short sketches of the subjects of the memoirs, is now some years behind date. Its arrangement, moreover, made it difficult at once to refer to any desired subject, and its cost put it out of the reach of many who would otherwise have bought it. To supply these deficiencies Dr. Staedel, of Tübingen, with the help of able coadjutors, has, for the last three years, edited the *Jahresbericht der reinen Chemie*. It is provided with a full index and a copious and well-arranged table of contents, with references to all the original papers of which short abstracts are made.

The arrangement of the work is as follows:—

I. General Chemistry.
II. Inorganic Chemistry. 1. Metals. 2. Metalloids.
III. Organic Chemistry.
A. Fatty Series. 1. Hydrocarbons. 2. Monatomic Alcohols. 3. Unsaturated Hydrocarbons. 4. Polyatomic Alcohols. 5. Carbo-hydrates. 6. Acids, Aldehyds, and Ketones. 7. Cyanides. 8. Amides, Amines, and Phosphines. 9. Amides of Carbonic Anhydride. 10. Uric Acid and its Derivatives.

B. Aromatic Series. 1. General Remarks. 2. Benzol Compounds, Amido-, Sulpho-, and Oxy-Substitution Compounds. 3. Toluol. 4. Zylol, &c. 5. Diphenyl, Tetraphenyl, &c. 6. Terpenes. 7. Camphor Group.
C. Naphthalene, Anthracene, Phenanthrene, &c.
D. Glycosides; Unclassified Animal and Vegetable Compounds.

IV. Theoretical and Physical Chemistry, comprising Thermo-Chemistry and Optical and Electro-Chemical Investigations.

V. New Apparatus and Lecture Experiments.

It is thus evident that the arrangement is thoroughly systematic.

It need hardly be remarked that investigators would materially further the object of this work, as well as render their investigations more widely known, by sending a copy of their memoir to the Editor. The *Berichte* is published in August, and its cost is about eleven shillings.

Notes on Milk, with Plain Directions for its Preservation in the Dairy, its Safe Transit by Railway, and an Exposition of its Dietetic Qualities generally. By R. J. ATCHERLEY, Ph.D., F.C.S. London: Published by the Author, 22. St. Mary Axe, E.C.

WE have here a pamphlet containing little but what is true, and also little that can be considered novel. The author thinks the "time must soon be at hand when sophistication will be completely checked." Yet he complains that the "Public Analysts of the day ground their statement of adulteration, or the reverse, upon the percentage of solids they find in the milk," and maintains that "milk varies exceedingly within certain limits." We perceive here an error: Public Analysts are generally guided not by the total percentage of solids, but by the proportion of "solids not fat,"—a much more constant quantity. We might ask, further, Upon what does Dr. Atcherley found his statement as to the variability of milk —upon hundreds of determinations of *genuine* samples made by himself, or upon results obtained by others making use of obsolete methods? But admitting, for argument's sake, that the composition of milk is very variable, we have then to enquire—How is "sophistication to be completely checked"? The author does not appear to have any more accurate method to propose in lieu of the determination of solids. If the milk-trade are informed, through a pamphlet expressly addressed to the proprietors of dairy-farms, that merely "a *crude* notion of the extent of the adulteration may be arrived at on considering the chemical and physical appearances jointly," we fear that the pump will be plied with increasing vigour.

Annual Announcement of the Stevens Institute of Technology, a School of Mechanical Engineering founded by E. A. Stevens, Esq., of Hoboken, New Jersey.

WE have often had occasion to point with admiration to the colleges and institutions for the promotion and diffusion of science, founded by the princely munificence of private citizens. We hold that the industrial eminence of a nation depends far more on placing the means of a sound scientific training within the reach of those who desire it, than upon forcing elementary schooling upon those who have no intellectual cravings. Among the colleges of the kind in question no mean rank belongs to the Stevens Institute of Technology, founded in 1870, and now in full and successful operation. In demonstration of its efficiency we may, on the good old principle that "the proof of the pudding is in the eating," refer to the contributions to Science that have emanated from the Stevens Institute during the five years of its active career. Thus Dr. H. Morton, the president of the college, has given to the world papers on the "Fluorescent Relations of Anthracen and Chrysogen," on the "Fluorescent Relations of a New Hydrocarbon found in Petroleum Distillates," on the "Fluorescent Relations of Chrysene and Pyrene," on the "Fluorescence and Absorption Spectra of the Uranium Salts," on "Certain Basic Salts of Uranium," on "Apparatus and Methods of Optical Projection," and on "A New Form of the Bunsen Burner," all of which have appeared in the CHEMICAL NEWS. Prof. Leeds, who worthily fills the chemical chair, has contributed papers on the "Spectroscopic Examination of Silicates," on the "Volumetric Determination of Chlorine," on the "Purification of Mercury," on "Alizarin as a Test," on the "Alteration of Albite and the Genesis of Deweylite," on "Unusual Occurrences of Phosphoric Acid," on a "Rapid Method of Double Weighing," on a "General Method of Spectroscopic Examination," and on the "Dissociation of Certain Compounds at Very Low Temperatures," in addition to valuable contributions to mineralogy. Prof. C. F. Kroeh has furnished papers on "Recent Developments in Quantitative Spectrum Analysis," on the "Magnetic Spectrum," on "Recent Progress in Electro-Magnetism," besides other memoirs. If we reflect that chemistry of necessity plays but a secondary part at the Stevens Institute, whose main functions are mechanical, we may certainly congratulate it on the position it has already taken, and on the future career of usefulness to which it may look forward.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—A point of some importance in the analysis o waters by Wanklyn and Chapman's method has lately been brought to my notice in a letter which I have just received from my brother, who is Demonstrator in the Mineralogical Laboratory of the University of Sydney.

In that laboratory a series of analyses of waters have been recently carried out, and it has been found that the amount of ammonia (free and albuminoid) varies very considerably according to the age of the sample.

I quote from my brother's letter: "I have made some 200 determinations of well-water, rain-water, pond-water, distilled water, distilled + urine, distilled + white of egg, and so on, and I find that a series of, say 12 or 20 bottles, all filled from the same source (well mixed) alter daily in the quantities of free and albuminoid ammonia; some of the samples free themselves from free ammonia quickly in ground-glass-stoppered bottles, others increase; even the albuminoid ammonia increases and decreases without apparently any fixed law."

Another quotation from the same letter is interesting:— "Distilled water, re-distilled in a clean copper still with sodium carbonate, first portion of distillate rejected: 3 litres collected, free from ammonia by Nessler's test, distilled this with 300 c.c. permanganate solution, and 180 c.c. saturated sodium carbonate solution; 1 litre, free from ammonia by Nessler's test, collected, re-distilled this with 60 c.c. sodium carbonate, and 100 c.c. permanganate solution; 500 c.c. collected free from ammonia; kept 38 days in ground-glass-stoppered bottle; determined free ammonia = 0·09 m.grm. per litre; albuminoid ammonia, none. One series of urines gradually decreased from 0·5 m.grm. per litre, in 14 days, to 0·005 m.grm. per litre." I cannot say whether the last quoted numbers refer to free or to albuminoid ammonia. My brother is still engaged with experiments bearing upon these results, and promises me full details when they are finished. I should be very pleased to learn whether any chemists who have had large experience in water analysis can corroborate these results; also whether, granting their accuracy, any plausible explanation of the facts can be given. Is it possible that the "germs" which have escaped decom-

position by the permanganate undergo a process of gradual decomposition in the water, and that ammonia is one of the products of this process?—I am, &c.,

M. M. PATTISON MUIR.

The Owens College, February 23, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 6, Febuary 5, 1877.

Oxide of Monochlorated Methyl.—M. C. Friedel.—The author finds that it is possible to form a stable group by replacing the chlorine in methyl-monochloric oxide with oxacetyl.

Diathermanous Character of Metals and of Paper.—M. Aymonnet.—Metals and paper are not athermanous, as is generally supposed. They are more diathermanous for obscure heat emanating from metallic bodies raised to a temperature below 100° than for thermic radiations which are luminous or bordering upon redness. Their absorbent powers are lower than that of water. It is possible to find a mathematical relation between the absorbent power of a body and its coefficient of conductibility.

Presence of Free Ammonia in Cast-Steel.—M. P. Regnard.—On breaking up ingots of steel made on Pousard's system the author noticed a very decided smell of ammonia. The odour was accompanied by a slight hissing, very distinct on holding the ingot to the ear. On covering the fracture with soap-water a froth was produced. These phenomena were witnessed by several persons, especially MM. Troost and Hautefeuille.

Effects of the Injection of Magenta into the Blood.—MM. V. Feltz and E. Ritter.—The authors find that the injection of pure magenta occasions paralysis, or convulsive agitation of the limbs.

Mineralogical Structure and Composition of Variolite from the Durance.—M. A. Michel Levy.—Not adapted for abstraction.

Determinations of Ammonia in the Air and in Meteoric Waters.—M. A. Levy.—The methods employed by the author present nothing remarkable.

No. 7, February 12, 1877.

Researches on Thermic Spectra (continuation).—M. P. Desains.—In a paper published in 1870 the author has shown that in the solar spectrum formed with an apparatus of rock-salt the heat which accompanies the luminous rays is about one-third of the total heat; on the other hand, in the spectrum of incandescent platinum it is a mere insignificant fraction. We arrive at analogous results with an apparatus of flint glass. The difference does not disappear on transmitting the rays of the incandescent metal through strata of water of greater or less thickness. The spectra of the electric light are much more similar to those of the sun, as the heat extends even into the blue.

A New Catalogue of Coloured Stars, and on the Spectrum of Schmidt's Star.—P. Secchi.—In Schmidt's star, in the constellation Cygnus, the author has verified the brilliant lines of hydrogen and magnesium and the yellow ray of sodium.

Adulteration of Food.—General Morin, M. Pasteur, and M. Dumas insist that the presence of magenta in wines, and of copper in preserved vegetables, is to be considered as a fraud, quite irrespective of the more or less decidedly poisonous character of these additions, and demand the absolute suppression of the practice.

Nitrification by Organic Ferments.—MM. Schloesing and Müntz.—The authors maintain that organic matter and ammonia are burnt in the soil by oxygen, under the mediation of organic germs.

Certain Alterations in Glass.—M. V. de Luynes.—The author finds that certain glasses, after long exposure to light, undergo a change which causes them to act upon polarised light in the same manner as tempered glass. If heated, a layer exfoliates, which is richer in silica than the interior mass. If this outer coating is broken, and water penetrates to the interior, the glass is soon destroyed.

Phosphorescent Organic Bodies.—M. B. Radziszewski.—The author has shown the existence of well-defined organic bodies—such as hydrobenzamide, amarin, and lophin—which are luminous in the dark if brought in contact with an alcoholic solution of potassa.

Fermentation of Urine.—Dr. H. C. Bastian.—A reply to M. Pasteur's last paper on spontaneous generation. M. Pasteur afterwards requested the Academy to nominate a commission to investigate and report, and expressed the hope that Dr. Bastian would make a similar application to the Royal Society.

Poisonous Character of the Salts of Copper.—M. Bergeron.—The author, in opposition to M. Galippe, declares that copper, even if innocuous in minute doses, is a poison, and that verdigris is not admissible in articles of food.

Means of Detecting Iodine in Cod-Liver Oil, and Experiments on the Absorption of Iodide of Potassium by Fatty Animal Matters.—M. B. Barral.—The author burns the oil in a small apparatus, described and figured in his original memoir, and searches for the iodine in the aqueous products of combustion. He finds by direct experiment that the milk of herbivorous animals, submitted to an iodised diet, contains iodine not merely in the serum, but also in the fatty matter.

Bulletin de la Societe Chimique de Paris, No. 12, December 20, 1876.

Detection of Magenta in Wines.—M. Fordos.—Second paper; already noticed.

Products of Condensation of the Ortho-Homologues of Benzol.—M. Bohuslaw Reyman.—A preliminary notice.

Relation Between the Chemical Equivalents and the Absorbent Powers of Bodies for Heat.—M. Aymonnet.—The author concludes that the absorbent atomic power seems to be constant—First, for simple bodies dissolved in the same medium; second, for simple bodies forming part of compounds of an analogous chemical constitution. Heat, he considers, has only one way of propagation, from atoms to atoms. The following law is proposed:—When the temperature of the source of a given nature rises, the absorbent power of the bodies submitted to the radiations of this source diminish all in the same proportion.

Dichlorated Naphthalin Corresponding to Nitronaphthyl-sulphurous Acid.—M. P. Cleve.—The author has obtained the dichlorated naphthalin in question in flat needles, readily soluble in boiling alcohol, but sparingly in cold alcohol, and fusible at 107°. On analysis 36·12 per cent of chlorine was found, instead of the 36·04 which the formula requires.

Determination of Arsenic by Standard Solutions.—MM. P. Champion and H. Pellet.—The process consists of the following operations:—Transformation of the arsenic into a sulphide; solution of the sulphide of arsenic in ammonia, and saturation with acetic acid; titration the arsenic with iodine in presence of starch.

Justus Liebig's Annalen der Chemie, Band 185, Heft 1.

Communication from the Laboratory of the University of Halle.—This consists of a paper on nitrosotriacetonamin, by W. Heintz.

On Picrorocellin.—J. Stenhouse and C. E. Groves.—Taken from the *Proceedings of the Royal Society*.

Communications from the Laboratory of the Pharmaceutical Institution in Breslau.—These consist of two papers by Dr. Möslinger, "On the Ethereal of the Fruits of *Heracleum Sphondilium*," and "Preparation and Description of Certain New Octyl Compounds."

Reten and Certain of its Derivatives.—A. G. Ekstrand.—Reten forms the chief part of a fatty substance known in Germany as tar-tallow (*Theer-talg*), and obtained as a semi-fluid oil towards the end of the operation of distilling wood-tar. The paper is very long, and incapable of useful abstraction.

On Maclurin.—R. Benedikt.—The author concludes that protocatechuic acid and phloroglucin are the only proximate constituents of maclurin.

Diethyl-methyl-acetic Acid, a New Isomer of Œnanthic Acid.—E. Schdanoff.

Pinakon and Pinakolin Formed from Methyl-ethyl-keton.—G. Lawrinowitsch.—These two papers are reprints from the *Bulletin of the Imperial Academy of Science of St. Petersburg*.

Revue Universelle des Mines, Sept., Oct., Nov., and Dec., 1876.

The only chemical matter in this issue consists of extracts from the *Comptes Rendus*.

Reimann's Farber Zeitung.
No. 5, 1877.

This issue is taken up with notes on machinery, an extract from certain lectures on woollen dyeing delivered last year before the Society of Arts, and a few receipts.

No. 6, 1877.

This issue contains a paper on the progress of the "hydrosulphite" vat, and an account of an action brought by a silk merchant in England against a dyer for not "weighting" certain black silks to the extent desired. We are happy to find that the plaintiff was unsuccessful.

No. 7, 1877.

The principal article in this number treats on brasilin, which, in accordance with the recent researches of Liebermann and Burg, is considered a lower stage of oxidation of hæmatoxylin, to which it bears the same relation as does alizarin to purpurin. There is a useful caution against practical joking in dye-works and similar establishments. A case of this kind near Rouen took, as is easily conceivable, a fatal termination.

Moniteur Scientifique, du Dr. Quesneville, February, 1877.

Observations on the Definition of Salts.—M. Felix Bellamy.—A bulky treatise extending to nearly thirty pages, and incapable of useful abstraction.

Migration of Gases.—M. Felix Bellamy.—Already noticed.

Combinations of Phthalic Acid with Phenols. M. Adolf Bæyer.—A translation from the *Berichte der Deutschen Chemischen Gesellschaft*.

New Physiological Researches on Pure Magenta.—MM. Bergeron and Clouet.—The authors contend as the result of their experiments that *pure* magenta is absolutely innocuous.

New Means of Synthesis by Means of Nascent Formic Acid.—K. Reimer and F. Tiemann.

Action of Tetrachloride of Carbon in an Alkaline Solution on Phenol (Formation of Salicylic and Paroxybenzoic Acids).—K. Reimer and F. Tiemann.

Constitution of the Compounds of the Coniferylic and Vanillic Series.—F. Tiemann and B. Mendelsohn.

Hydrochlorate of Glycosamine.—G. Ledderhose.

These four papers are extracts from the *Berichte der Deutschen Chemischen Gesellschaft*.

Benzolic Nucleus of M. Mehay.—M. Noelting.—A hypothetical note extracted from the *Annalen der Chemie*.

Les Mondes, Revue Hebdomadaire des Sciences, No. 1, January 4, 1877.

Phenomena of the Synthesis of Gases in Plants.—M. Merget.—Two cylindrical glass jars of 300 c.c. capacity were placed with their open ends in a large vessel of water. The one was filled with hydrogen, the other with oxygen, and they were connected internally by a branch sufficiently long to reach their extremities. The level of the water gradually rose in each cylinder, and the gases ultimately disappeared. At the beginning of the experiment the volumes which disappeared were almost equal, but as the level of the water ascended in the two cylinders, and as the emerging portions of the branch became shorter, the volume of hydrogen disappearing approached more and more nearly to double the volume of the oxygen. If a similar experiment was made with hydrogen and nitrogen in the two cylinders, the volume of the former gas which disappeared was three times as great as that of the latter. On operating with hydrogen and carbonic oxide the two gases still disappeared, but in very variable proportions.

NOTES AND QUERIES.

Steel Analysis.—Would any of your numerous correspondents describe a method for the determination of tungsten and titanium when present together in a sample of steel?—CHEMIST.

Black Pigment or Dye.—A few years ago the discovery of a new *black* was announced. I think it was in your excellent journal, which, as stated, placed in juxtaposition with ordinary black, the latter looked pale. I shall be much favoured if you or any correspondent can kindly inform me whether this black is suited for use as a pigment or a dye for the surfaces of wood, paper, or metal, and where it can be procured?—W. R.

Rusting of Steel.—I am much annoyed by the rusting of steel springs employed in the valve cases of a "Euphonium;" directly the silver plating wears and exposes the steel, galvanic action helps the destruction of the springs; the wet to which they are exposed is of a very corrosive nature. Can I in any way protect steel so that it can be used in the situation mentioned; the usual springs are of brass, but they have the defect of soon losing their power and being rather sluggish in their action.—F.R.M.S.

Iron.—A sample of iron-ore which consisted almost entirely of Fe_2O_3 was dissolved in HCl, HNO_3 added, and boiled, to entirely peroxidise any protoxide that might be present, the solution filtered from the siliceous matters, the filtrate precipitated with an excess of NaHO and boiled; the Fe_2O_3 thus separated was filtered off, washed, and re-dissolved in HCl; again precipitated with NH_3, collected on a filter, washed until free from chlorine, dried, and ignited with the usual precautions where reduction is to be apprehended. The precipitated when dried was of a *very dark colour*, was ignited separately from the filter ash in a porcelain crucible over a spirit-lamp upon cooling was of a dark shining lustre approaching black, and found to be magnetic. moistened with HNO_3 and re-ignited was still magnetic this should not be with Fe_2O_3. Will some of your readers who are constantly working on Fe_2O_3 kindly point out the cause? Consequently, what I have omitted to do and any other information on the subject will be esteemed.—PEROXIDE.

[See notes by J. Robbins, CHEM. NEWS, vol. i., pp. 11, 119.—*Ed.* C.N.]

TO CORRESPONDENTS.

E. B.—Paper may be parchmentised by soaking in moderately strong sulphuric acid, and then well washed.

W. K.—(1) "Watts's Dictionary of Chemistry." (2) Of any dealer in minerals, or if you want large quantities you should advertise.

MEETINGS FOR THE WEEK.

SATURDAY, 3rd. Physical, 3. "Theory and Construction of Holtz's Machine." Mr. W. J. Wilson.
MONDAY, 5th.—London Institution, 5.
—— Medical, 8.
—— Royal Institution, 2. General Monthly Meeting.
—— Society of Arts, 8. (Cantor Lectures). "Chemistry of Gas Manufacture," A. Vernon Harcourt, F.R.S.
TUESDAY, 6th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Zoological, 8.30.
—— Society of Arts, 8, Conference on the Patent Law Amendment Bill.
WEDNESDAY, 7th.—Society of Arts, 8. "Growth and Present Position of the Science of Machines," Professor Kennedy, C.E.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 8th.—Royal, 8.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Society of Arts, 8. (Chemical Section). "The Sizing of Cotton Goods," W. Thompson, F.C.S.
FRIDAY, 8th.—Royal Institution, 9. "Future of Steel," Mr. F. J. Bramwell.
—— Astronomical, 8.
—— Quekett Club, 8.
SATURDAY, 10th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."

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APPOINTMENT OF ANALYST.

The Board will, at their meeting to be held at the Offices, on Tuesday, the 13th day of March next, at 6 o'clock p.m., be prepared to receive Applications from duly qualified persons, according to the provisions of the "Sale of Food and Drugs Act, 1875," desirous of being appointed Analyst of this District for a period of One Year at a salary of £100, the minimum number of analyses to be made during the year to be one hundred. Candidates will have due notice when they are required to be in attendance. The Laboratory, with all appliances, has been provided and will be maintained by the Board. Applications, accompanied by not more than two testimonials, addressed to the Board of Works for the Poplar District, 117, High Street, Poplar, endorsed "Application for the Office of Analyst," will be received till 12 at noon of the said 13th day of March next.

The attention of Candidates is particularly called to the 10th Section of the Act, which provides that no person shall be appointed an Analyst of any place who shall be engaged directly or indirectly in any trade or business connected with the Sale of Food or Drugs in such place.

No expenses will be allowed to any Candidate.

WM. HENRY FARNFIELD.
Clerk to the Board.

Offices, 117, High Street, Poplar,
February 19, 1877.

MANCHESTER CORPORATION GAS-WORKS.—TO TAR DISTILLERS AND OTHERS.—The Gas Committee are prepared to RECEIVE TENDERS for the Purchase of the Whole or Portion of the GAS-TAR to be produced at their Gaythorn and Rochdale Road Works for the term of one or more years, as may be agreed upon, commencing on the 1st day of March, 1878. The total quantity that will be produced during the first year is estimated at 15,000 tons or thereabouts. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Gas-Tar," must be delivered at this office on or before the 20th day of March next. The Committee do not bind themselves to accept the highest or any tender.—Further particulars as to conditions of contract and forms of tender may be obtained on application to Mr. Jackson, at the Gas Office.—By order of the Gas Committee.

JOSEPH HERON, Town Clerk.

Gas Office, Town Hall, Manchester, 27th January, 1877.

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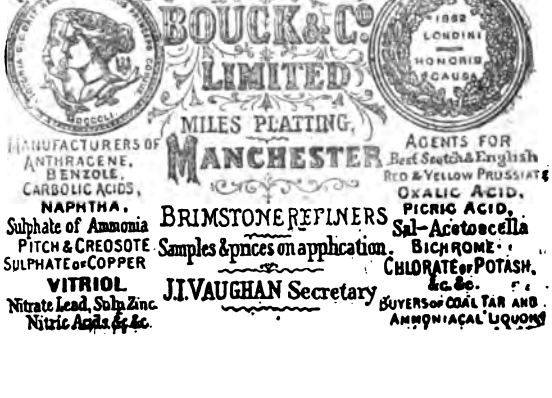
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THE CHEMICAL NEWS.

Vol. XXXV. No. 902.

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

By P. CASAMAJOR.

First Paper.—On a New Portable Burette.

The necessity of estimating potassa and soda in their commercial carbonates with accuracy and rapidity, gave rise to volumetric analysis, and I believe that Descroizilles was the first chemist who substituted the measuring of a certain volume of acid of known strength for the slower and more delicate operation of weighing.

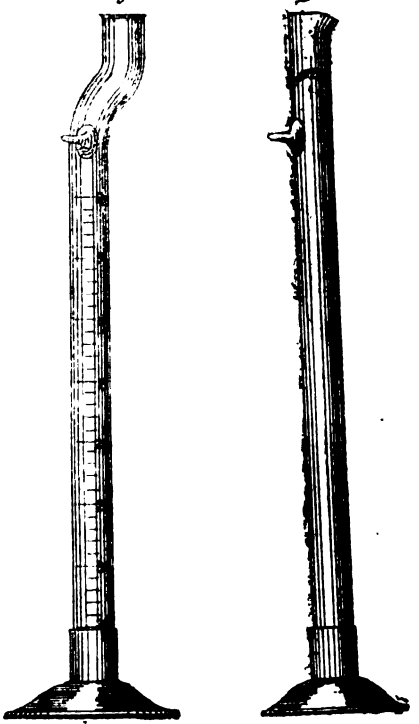
To ascertain the exact volume of sulphuric acid required to saturate a known weight of alkali, Descroizilles used a graduated tube about 25 centimetres high, with a diameter of 15 millimetres. This was provided with a very narrow neck, whose upper portion was expanded and provided with a lip. On the shoulder, near the base of the narrow neck, was a small opening, which, by being closed more or less perfectly, by the application of a finger, allowed the titrated acid to run out with more or less rapidity. The word *burette*, applied to this instrument, was very appropriate, as in French *burette*, as defined by Boiste,† is a small flask with a narrow neck, and is a diminutive of *buire*, which means a large flask. This word was adopted afterwards by Gay-Lussac to designate his graduated drop tube, and it has been applied to all instruments designed to fulfil the same purpose, whatever be the variety of their shapes.

In the burette of Gay-Lussac, which was the immediate successor of the instrument of Descroizilles, the liquid is poured out through a very narrow tube, which may have been suggested by the narrow neck of the primitive flask. This burette has the advantage over some other forms now adopted that it is made entirely of glass, and is therefore able to hold any of the test liquors used in volumetric analysis, and also that its contents can only run out when the instrument is in the hands of the operator. I believe that it is generally preferred to other forms, and that more of them are sold than of any other kind. Two other burettes are in general use, in both of which the liquid drops directly from the bottom of the graduated tube, its flow being regulated either by a glass cock, or by a pinch cock acting on a flexible rubber tube. This latter instrument is the invention of Dr. Frederick Mohr, and we may say of it that, for solutions which have no action on india-rubber, no better burette could be desired.

In the investigations which I lately made on the "Estimation of Potassium as Acid Tartrate," which I had the honour of laying before you at our September meeting, I had repeatedly occasion to use a titrated solution of potassic hydrate, which could not be held in Mohr's burette, on account of the rubber tube. A burette with a glass cock, which I used at first, was finally laid aside, as the normal alkaline solution was continually leaking out around the key of the cock. This key itself fitted very perfectly, but it had to be slightly loosened from its seat to allow it to be turned with nicety, and the play left in this manner was sufficient to let a portion of the contents leak out, and, as the whole of this did not find its way to the beaker glass, but some remained on the outside of the burette, errors were committed which materially affected my results. A burette of Gay-Lussac gave much more satisfactory and concordant results, as no leakage took place under any circumstances. This burette, however, is inconvenient to use because a constant watch must be kept on its liquid contents if the outflow is to be regulated with precision, and this is not an easy matter, as the attention of the operator is divided in observing both the outflow and the effect of the test liquor on the solution in the beaker glass. This defect is aggravated by the circumstance that, towards the end of the operation, when the effect of every drop of test-liquor on the solution under examination has to be watched with the closest attention, the management of the burette becomes the most difficult, on account of its greater deviation from a vertical position.

Having suffered a great deal of inconvenience from this defect, I endeavoured to overcome it by several devices, and was finally led to adopt an entirely new form of burette, which I find more convenient than any other with which I am acquainted, and which it is my business to describe to you this evening.

Fig 1 Fig 2.



The burette represented in Fig. 1 and Fig. 2, is a cylindrical tube closed at the bottom. For the sake of convenience and safety this tube is inserted in a stand or foot, in the manner proposed by Dr. Mohr for Gay-Lussac's burette. This foot is made of japanned tin, which is better in every way and more economical than wood. The cylindrical portion of this tin stand is only partially soldered on the flat part, to allow the portion left free to act as a spring in holding the glass cylinder tightly.

The upper portion of the glass tube has the shape shown in Fig. 1, to prevent the liquid from running out when the tube is inclined. The same object is usually accomplished by bending the upper portion at an obtuse angle on the main stem; but I have preferred the shape shown in Fig. 1, as the burette is more easily filled while standing vertically on its foot.

Immediately under the curved portion of the burette is a beak, from which the liquid drops when the instrument

* Read before the American Chemical Society, November 7, 1876. Communicated by the author.

† The definitions of Boiste are as follows:—Buire—*s. f.* flacon—grand vase. Burette—*s. f. Urceolus*—petite buire—vase à petit goulot pour l'huile; pour l'eau et le vin à la messe.

is inclined and properly turned. By making a transverse section through this beak we obtain Fig. 3 and Fig. 4, which show the shape of the beak, and its portion in relation to the stem for two positions of the tube.

To allow the liquid to drop from the burette it is inclined as in Fig. 5, in which position the curved position at the upper end prevents the liquid from pouring out. Keeping the tube inclined as in this figure, we may either prevent the outflow of its contents or allow it to run with more or less rapidity. To effect this it is merely necessary to turn the instrument around its own axis, so that the beak may be either raised or lowered, as shown in Fig. 3 and Fig. 4. When the beak is allowed to take the position shown in Fig. 3, the liquid in the tube does not run out, while in the position shown in Fig. 4, the drops run out quite rapidly. At some intermediate point, it will be found that the liquid runs out slowly in drops, which may be accelerated or retarded by turning the tube around its axis, but without changing the inclination of this axis.

The motion imparted to the burette by holding it in the hand, and simply turning it around its axis is an easy one for the operator, who is not obliged to watch the liquid in the instrument with any degree of attention. As the liquid runs out of the burette it becomes necessary to incline its axis more and more, to keep a supply of liquid near the beak; but there is no difficulty connected with this, as the liquid runs out with equal ease when the instrument is full to the O mark as when it is nearly empty. When the changes which occur in the liquid under examination indicate that the operation is nearly

Fig. 3.

Fig. 4.

ended, the liquid may very easily be made to fall in single drops by turning the beak down gradually, and raising it again with a sudden motion. This is easily learnt by a little practice, and does not require a close watch on the contents of the burette.

The most convenient position for the operator is to hold the tube almost horizontally and to let the foot roll on a block of proper height, while the necessary motions are given to the instrument by holding it with one hand near its open end. This presents the additional advantage that the portion which becomes heated by the hand is not in contact with the liquid contents of the tube.

This position, however convenient, is not necessary, as it does not happen with this burette as with Gay-Lussac's, that almost every time the instrument is partially raised, a little drop of test liquor settles at the end of the small tube and prevents further outflow, which is a source of endless annoyance and delay.* As the beak always remains full of liquid, this new burette is ready to give a drop whenever the tube is properly inclined and turned.

Whenever it becomes necessary to lift the instrument, the beak should be previously raised by turning the tube, as otherwise a drop of liquid may escape and run down the side of the tube. After the operation is ended, the burette should be left in a vertical position for some minutes, to allow the liquid to run down before reading the indication of the scale. As the beak holds by capillarity a certain quantity of test-liquor, it will be found convenient to keep it full whenever the indications of the scale are observed. This beak usually becomes filled of itself at the time of filling the instrument with test-liquor. The open end of the burette may be provided with a lip on the side opposite to the beak, as shown in Fig. 2. This is to allow the test liquor to run out faster when desired.

Many chemists are unwilling to trust volumetric analysis for fear of the changes of volume which are due to changes of temperature. They are, however, willing to

Fig 5.

Fig. 6.

use the solutions of this method of analysis, and they have adopted a gravimetric system, which consists in weighing instead of measuring their test liquors. For this manner of using test solutions, I have made the gravimetric burette represented in Fig. 6. The manner of using this burette is precisely the same as for the volumetric instrument, and it does not require any further explanation.

The weight of test solution used in an analysis is best determined by double weighing. The flask or gravimetric burette, containing a greater quantity of test solution than will be required by the analysis, is placed on the scales and counterbalanced with shot or any other material. After the operation is ended, the flask should be replaced on the same pan of the scale and be made to counterbalance the original quantity of shot by adding weights, which represent the weight of test solution that has been used. A common balance weighing 200 grms. and turning to 1 centigrm., is sufficient for this method of testing.

The Chemical Society's Dinner.—We would remind Fellows of the Chemical Society that the Dinner, under the presidency of Professor Abel, will take place at Willis's Rooms on Tuesday week, March 20th. A full gathering may be expected to rally round so popular a president.

* This occurs principally with alkaline solutions. If the small tube of Gay-Lussac's burette is carefully watched, it will be seen, that when an alkaline solution runs down this tube, the main portion of the liquid fills up the tube; but it is preceded by a low wave, which keeps ahead of the main portion, however fast or slow the liquid runs down. This wave arrives at the nozzle before the other portion and fills it, leaving a volume of air between the two portions. With acid solutions the wave does not exist, and the tube is seldom stopped. The plan usually adopted to renew the flow, when it has been stopped by a drop of liquid at the nozzle, is to blow into the main tube. This is very objectionable, as by blowing we may obtain a small stream but not a drop. Toward the end of an operation this might spoil a test. The possibility of obtaining a drop at any time with ease and certainty is the great desideratum in a burette.

PYROLOGY, OR BLOWPIPE CHEMISTRY.

By MAJOR ROSS, late R.A.

(Continued from vol. xxxiv., p. 177.)

A DIGRESSION from the immediate subject of my last paper on this science may be permitted by my readers for the purpose of briefly examining two interesting articles which appeared in the last number (3) of the *Mineralogical Magazine*.

The first, from the pen of Dr. Foster, the *facile princeps* of pyrologists in England, contains a truly admirable "Defence of the Late Dr. Turner's Method of Detecting Boric Acid in Minerals, &c.," against the attack made upon it (published in the CHEMICAL NEWS, vol. xxxv., p. 36) by Prof. Chapman, of Toronto.

The second article is a too brief review of Part I. of the fifth edition of Plattner's "Probirkunst," &c., just published by Prof. Richter, of Freiberg; evidently written by some-one well acquainted with the subject.

With reference to Turner's boric acid test, Prof. Chapman stated (1) that it "fails entirely" to detect boric acid in *borax*; and (2) that "most other borates and borosilicates colour the flame equally well *per se*."

As sodium, or rather the orange flame which sodium salts exhibit more strongly than any other substance, is the chief preventer of the recognition of boron in a flame, Dr. Foster details six experiments, the last of which shows the effect of the combustion of a mixture of 99 parts of common salt with 1 of borax, which, by Turner's method showed, on the edge of a Bunsen flame, "a decided green colouration." Before the blowpipe this mixture failed to give any indication of boric acid, but one of 98 parts salt with 2 of borax "gave a decided green" before the blowpipe.

These careful and conclusive experiments must surely satisfy Prof. Chapman of the general erroneousness of his first assertion, the rather that he does not appear to have made any inductive experiments in the matter himself.

As regards Prof. Chapman's second statement, that minerals containing borates colour the blowpipe flame *per se*, it is amazing to think he should chiefly depend for its verification upon the assertion of a French gentleman, Buzengeiger, made in 1829, who, moreover, according to Prof. Chapman's own quotation, says he was so unaccustomed to the use of the blowpipe that he could not succeed in obtaining an indication of boric acid from a borate by the use of Turner's flux (!)

After such a confession as this, there is nothing surprising, and still less convincing, in the additional statement that he deluded himself and some few others into the idea that "tous les mineraux que M. Turner a vu colorer la flamme en vert en les melant avec son flux m'ont donné la meme réaction en les introduisant avec quelque soin dans la flamme bleue, sans les mélanger avec aucun réactif." "Methinks" M. Buzengeiger here, "doth prove too much."

Prof. Chapman states that "all specimens of *Axinite* colour the flame green, *per se*," and if green-yellow is to be termed "green" the statement may be allowed to pass without criticism; but he does not assert that specimens of *Tourmaline* do anything of the sort, although by the use of Turner's flux most afford a vivid boron green for a few seconds.

The real defect of Turner's method is that the reaction is too ephemeral. I have attempted to remedy this defect by the use of a solution of copper (*vide* "Pyrology," pp. 191, 192), and I should be glad to hear if Dr. Foster has tried and succeeded by my method with (for instance) such minerals as *Tourmaline*?*

The want of a thoroughly effective pyrological test for boric acid is the more felt, because such could probably be made *quantitative*; and, according to H. Rose ("Chemie Analytique," vol. ii., p. 939, 1862)—"The quantitative determination of boric acid presents great difficulties: if in aqueous solution the total quantity cannot be determined by evaporation, and if in alcoholic solution it is volatilised by evaporation, even when conducted by very gentle heat, in still greater quantity than in an aqueous solution."

"Plattner's Assaying with the Blowpipe," fifth edition, Leipsic, 1877, edited, as before, by Prof. Richter, Director of the Freiburg School of Mines, has just issued (or, at least, Part I., containing about one-fifth of the entire book has issued) from that celebrated university.† The reviewer, evidently an experienced pyrologist himself, states that "the amount of new matter in the first part seems to be small, and has been introduced at the expense of some portions of the previous edition, for 144 pages of the new edition cover the same ground as 148 of the old. This diminution in size is partly due to the use of smaller type." After stating that potassium iodide and sulphur for detecting bismuth find a place among reagents here, which they did not in the last edition—though, by the way, the whole reaction is detailed in Prof. Cornwall's translation of the fourth edition, in the appendix—the reviewer goes on to say—"Reference is made to the labours of Emerson, G. Rose, Sorby, and Wunder, but we are surprised to find that no notice whatever is taken of Major Ross's work on 'Pyrology.' Surely Prof. Richter must have seen the book, and we should have liked to have heard his opinion—that of the greatest authority living for such matters—on Major Ross's new methods of testing; the aluminium plate as a support; use of boric and phosphoric acids as reagents, &c. . . . We are glad to see that he advises that the fused boric acid should be kept in fragments and not in powder, as was formerly recommended. We look forward anxiously to the completion of the work, when perhaps some remarks will be made on Major Ross's methods of assaying, both qualitatively and quantitatively."

I feel indebted to the reviewer for his evident kind wishes towards me and my work, but fear he will be disappointed in his hopes regarding us. It would be too much to expect notice of any kind in Plattner with reference to an almost entirely new mode of analysis. Each must stand on its own ground in the future.

* *Zoisite* paste thus gives a yellow flame, *Tourmaline* a green one.

† Since this article was in type Dr. Richter has written to me, kindly promising to send me a copy of his work when completed.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 1st, 1877.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the visitors had been announced and the minutes of the previous meeting read and confirmed, the names of Messrs. J. R. Young, S. S. Bell, W. Watson, and F. W. Toms were read for the first time. Messrs. Edward Hunter, Frederick Charles Cresswell Hewett, William Terrill, Alexander Kinninmont, John Borland, W. Handsel Griffiths, and George A. C. Pearce were ballotted for and duly elected Fellows after their names had been read the third time.

The PRESIDENT then read the list of officers and other members of council proposed for election at the Anniversary Meeting, and announced that there would be a Special General Meeting held afterwards, to take into consideration the proposals of the Council relative to alterations in the bye-laws regarding Associates, and on the form of obligation to be signed by Fellows on admission.

The SECRETARY also gave notice that those Fellows who wished to be present at the Chemical Society's Dinner at Willis's Rooms, on March 20th, should at once send in their names to Mr. Hall, at Burlington House.

The PRESIDENT then called on Prof. THORPE to give his lecture "*On the Theory of the Bunsen Lamp*." The

speaker, after some preliminary remarks as to the great value of this lamp, both to the scientific chemist and in the Arts, pointed out the origin of it at the time when Bunsen introduced coal-gas into his laboratory: he considered the contrivances which had been used in this country as unworthy of the fuel they had to burn, and, bringing his own inventive powers to bear on the subject, the Bunsen lamp was the result; the original apparatus differing but little from that now generally in use. After a short description of the lamp, the mode by which the air is drawn in at the holes at the bottom, and caused to mix with the gas, was considered. This is due to the well-known fact that when a gas issues from an orifice under pressure it carries with it more or less of the circumjacent air, partly as the result of the expansion, and partly as the result of its viscosity. This was experimentally illustrated by an ingenious adaptation of List's multiplying manometer, which, when connected with one of the holes at the base of a Bunsen lamp, distinctly showed the rarefaction produced by the gas as it issued from the jet, despite its low pressure. The intermixture of the gas and air in the tube is greatly facilitated by the spreading out of the gas-stream after leaving the jet, and the amount of air carried in varies of course with the size of the air-holes, being in an ordinary burner from 2 to 2½ times that of the gas. An average lamp, giving a flame 120 m.m. high, burns about 80 litres of gas per hour, so that as much as 250 litres of mixed gases pass through the tube of the lamp in that period of time. In some modifications of the lamp, such as Wallace's, the proportion of air is very largely increased, but then it is necessary to resort to some such contrivance as a perforated cap to prevent the flame retreating down the tube and burning below; for from Mallard's observations on the maximum rapidity of the propagation of combustion, it is evident that the velocity of the current of mixed gases in the tube of the Bunsen lamp would have to exceed that of the velocity of the propagation of combustion, in order that the flame should not retreat down the tube. Having traced the progress of the mixture of air and gas up the tube, attention was directed to the flame itself, which is hollow, and contains a large internal area of the uninflamed mixture, as it has been found that a mixture of gas with less than 3½ times its volume of air will not burn; it is only, therefore, when it meets with an additional supply of oxygen from the surrounding air that combustion occurs. The composition of the gas in the uninflamed interior cone is not the same in every part, however, as has been shown by Blackmann, the amount of hydrogen, of the hydrocarbons, and of oxygen diminishing, and that of the carbonic oxide, carbonic acid, and especially the aqueous vapour and nitrogen, being largely increased, the latter being derived from the surrounding air. This was still more clearly shown in a table giving the amount of air mixed with 100 vols. of gas, both in the tube and at various distances above it. The cause of the rapid diminution in the proportion of hydrogen, and the corresponding increase in aqueous vapour, is to be sought for in the greater diffusive power of the gas, and the lower ignition point of a mixture of hydrogen with air. If the supply of air be cut off from the air-holes at the bottom of the Bunsen lamp, the flame becomes luminous, so that the non-luminosity of the flame is due to the air, and at first sight it would be imagined that it was due chiefly, if not entirely, to the oxygen in the air, since it is known that an admixture of air with coal-gas greatly decreases its luminosity; the nitrogen, however, is concerned in the matter, for if, instead of supplying air at the holes at the bottom of the lamp, we supply nitrogen, or even steam, the flame at once ceases to be luminous, showing that the oxygen of the air is not necessarily the true cause. Knapp has shown that any indifferent gas, as carbon dioxide or hydrochloric acid, will produce the same result. Frankland proved many years ago that a mixture of marsh gas and air, which was almost destitute of illuminating power, might be made to give a luminous flame by heating the gas to redness, and Wibel has recently shown that the ordinary Bunsen flame is luminous when the gas is previously heated. This fact was experimentally illustrated by means of a Bunsen lamp with a platinum tube: when the latter was heated to redness by means of a blowpipe, the flame became luminous, as when the air supply is cut off from the holes at the base. The feeble luminosity of the Bunsen flame would appear to be due to a variety of causes, such as the oxidation of luminiferous material, the action of the nitrogen and other diluting gases, and the withdrawal of heat by the indifferent gases, such as nitrogen, carbon dioxide, and water vapour, for, although the temperature of a flame of coal-gas mixed with air is higher than that of one of unmixed coal-gas, it requires a still higher temperature in order to become luminous. When the gas is lowered in the Bunsen lamp, and the flame becomes very small, it will be seen that it does not rest immediately upon the end of the tube—a fact due to two causes, namely, the cooling action of the tube, and to the velocity of ignition of the mixed gases being less than the rate at which they issue. When the flame is very small, we all know that the least current of air causes the flame to retreat down the tube and ignite the gas at the jet below; this is due to an admixture of air causing the velocity of ignition of the mixed gases to become greater than the rate at which it passes upwards in the tube. When the flame burns at the bottom a very much smaller quantity of air passes into the tube, and the gas which issues at the top is entirely deprived of oxygen, and has, moreover, a disagreeable odour arising in part from the presence of acetylene formed by the imperfect combustion of some of the hydrocarbons present; the amount of carbon monoxide also is very largely increased. The pernicious effect of this partially burned gas is due to the acetylene and carbon monoxide thus formed.

The PRESIDENT, in thanking the lecturer, remarked that it would have been difficult to select a subject having a more special interest for working chemists; he had brought before them facts with which many were only generally or very partially acquainted, and made them familiar by his explanations and admirable experimental illustrations. Of those points of interest in the theory of the Bunsen lamp which had been mentioned, perhaps those bearing on the luminosity of flames were of the greatest interest at the present time, when so much attention was being directed to the subject.

Dr. FRANKLAND said that, although he had not paid any special attention to the luminosity of the Bunsen flame, it had been a point of special interest to him to ascertain the cause of the greater or less luminosity of flames under certain conditions. With regard to the effect of dilution on the luminosity of the Bunsen flame it had been advanced that when gases containing oxygen had been employed, such as carbonic anhydride, they had given up their oxygen, but there could be no doubt that this was not the case when nitrogen was used. From his own experiments it was evident that a comparatively slight elevation of temperature has a great effect on the luminosity of a flame which was just on the point of becoming luminous. He had resumed his researches on the luminosity of flames, and might say that he had repeated the very important experiments of Heumann, whose details of results he had found to be most accurate. He might mention that the exceedingly luminous flame of phosphuretted hydrogen did not give the faintest shadow in bright sunlight, showing that no solid matter was present in it; but as to whether the luminosity of carbonaceous flames was due merely to the great density of the hydrocarbon vapours, or to solid particles of carbon, was a matter which must still be considered as *sub judice*. The two important points to be determined were the presence or absence of polarised light in carbonaceous flames, and as to whether a flame whose luminosity was undoubtedly due to the presence of solid particles would behave in the same way under diminished pressure as hydrocarbon flames, such as that of a candle, &c.

Mr. VERNON HARCOURT wished to ask the lecturer whether the luminosity of the Bunsen flame, when the tube was heated to redness, might not be due in part to the formation of tarry matters or of hydrocarbons containing a large proportion of carbon, as it was not possible that the mixture of gas and air could be passed through the red-hot tube without undergoing considerable change.

Dr. WRIGHT suggested that the effect of heating the tube was comparable with that produced by lighting the jet below.

Prof. THORPE replied that Heumann had very carefully examined into the matter, and had found that when the experiment was properly performed there was no deposit of tarry or carbonaceous matter in the tube. If a much longer platinum tube to the Bunsen were employed, and only the lower part heated so that the gases became cooled again before being burnt, the lamp gave a non-luminous flame, showing that the luminosity was chiefly due to the heating. In reply to a question put by Prof. Foster, he said that when a cold body was introduced into the luminous flame soot was deposited on it.

The PRESIDENT, after a formal vote of thanks to the Lecturer, adjourned the meeting until Thursday, March 15, when the following communications will be read:—(1) "Note on a Method for Estimating Bismuth Volumetrically," by Mr. M. M. P. Muir; (2) "Note on Gardenin," by Dr. J. Stenhouse and Mr. C. E. Groves; (3) "Preparation of Copper-Zinc Couples," by Dr. J. H. Gladstone and Mr. A. Tribe; (4) "On Chromium Pig-iron," by Mr. E. Riley.

PHYSICAL SOCIETY.

March 3rd, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following were elected Members of the Society:—Mr. J. A. Fleming, Mr. P. le Neve Foster, and Mr. S. Hall.

Prof. FOSTER showed experimentally the polarisation of heat-rays, employing the large Nicol's prisms of 2⅝ inch aperture, and a thermopile surrounded by a double jacket and connected with a Thomson galvanometer, as arranged by Mr. Latimer Clark for showing very slight indications to an audience. When the principal sections of the prisms were at 90° to each other, only a slight movement—doubtless due to an initial heating of one side of the pile—was observed; and the amount of the deflection was found to increase steadily up to about 60 divisions on the scale as the above angle was diminished. Prof. Foster exhibited the results of experiments made to determine the intensity of a source of heat by this means, and they were very concordant.

Mr. LATIMER CLARK then explained the arrangement of the galvanometer used. The image of an arrow-head, or other form of index, projected by means of a lime-light at the further end of the room, traverses a telescopic object-glass about 2 ft. distant from the lamp, and falls on a square silvered plate of glass suspended from the needle of a Thomson galvanometer, which is rendered steady in the ordinary way by a platinum spade in water. The reflected image then traverses the whole length of the room, and falls on a large scale placed in front of the audience, and, by such an arrangement, the instrument may be at any distance from the scale and yet the image will not be unduly magnified. A method is employed for bringing the needle rapidly to rest. A few thermo-electric couples are placed above the lamp-chimney, thus being kept constantly hot, and the terminals are united by a wire which is coiled several times round the galvanometer; the circuit is completed at the moment when this subsidiary current will tend to neutralise the motion of the needle.

Prof. GUTHRIE incidentally mentioned that the difficulty experienced in separating the fibres of a cocoon-thread may be obviated by boiling the thread in carbonate of potash, when the natural resin is saponified and the fibres may be easily split.

Mr. WILSON then explained some difficulties he has met with in constructing a Holtz electrical machine, especially with reference to the windows and armatures; and he exhibited two machines which he recently made, from one of which a spark 5 or 6 inches in length can be obtained: this apparatus is so arranged that it can be taken entirely to pieces and packed in a very moderate-sized case. After carefully pointing out the difference between an ordinary machine and the Birch machine, he proceeded to consider the theory of the Holtz machine, and explained how he was led to construct an instrument in which there were no windows, the armatures being placed on the face of the fixed plate next to the moving plate, but the result was not satisfactory. He then made the larger machine provided with six fixed and six moving plates, and the windows were replaced by holes ¼th inch in diameter, traversed by short pieces of tape glued to the paper armatures. The initial charging of the armatures is effected by means of a disk of ebonite fixed to the main axis of the machine, which is lightly held by the fingers and caused to rotate. Electricity is thus generated, and points projecting towards it and communicating with points in the neighbourhood of the armature cause them to become charged; after this electricity is generated with great rapidity.

Prof. MCLEOD gave some details concerning the working of a large Holtz machine which he drives by a turbine. He finds that after it has been in action for nearly an hour a much greater force is required to work it, and he suggested a theory in explanation of this phenomenon. By keeping the machine dry, under a glass shade, reversing effects are entirely avoided, as well as the necessity for varnishing the plates.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 6, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

"*On the Powerful Oxidising Action of Animal Charcoal upon Organic Matters as shown by the Analysis of the Drainage from a Large Heap of a Mixture of Night-soil and Animal Charcoal*," by WILLIAM THOMSON, F.R.S.E.

I had occasion some time ago to examine a sample of the fluid which had drained from a large heap of several thousands of tons of a mixture of night-soil and animal charcoal, which had lain for about one year or more, covered over with clay and pitch to prevent the rain from washing it away. This heap was about 7 or 8 feet in height, and the drainage from the whole which could be collected, did not amount to more than an average of about 12 gallons in 24 hours. It exuded from the heap in minute streamlets which drained down its sides, and at no part of this immense collection of oxidising organic matter could the slightest unpleasant odour be detected. The liquid which drained away was mixed with a small amount of suspended matter, which, however, soon settled to the bottom, leaving a perfectly colourless solution which was quite free from smell, but possessed a strong saline taste, and when treated with hydrochloric, sulphuric, or other acid it produced a copious effervescence.

This liquid was submitted to a very careful analysis in the following manner:—

1. 50 c.c. of the liquid was evaporated to dryness in a tared platinum capsule and heated in an air-bath at 220° F. till it ceased to lose weight, and its weight then noted.

2. This residue was then heated for some time to

redness to destroy and free it from any organic bodies and again weighed.

3. The remaining mineral matters were then submitted to analysis by separation of the different salts by means of alcohol of different strengths to corroborate the results of the more exhaustive analysis.

4. 5 c.c. of the solution were mixed with 245 c.c. of pure water, free from ammonia, distilled, and the free ammonia determined by means of "nesslerising" to show the proportion of ammonia in combination with carbonic acid. Pure carbonate of soda solution and pure water were added to the liquid remaining in the retort, and it was again distilled till the distillate ceased to show any colouration by the nessler test, and the ammonia from this distillate estimated by nesslerising. This operation would give the proportion of ammonia, which, although in the analysis of potable water would be termed "free ammonia," would in this case be in combination with hydrochloric acid. More pure water and permanganate of potassium were added to the solution, again remaining in the retort, and the liquid again boiled and the distillate collected with the same precautions as before, and the ammonia contained in it estimated. This should give an approximate idea of the nitrogen which is contained in the water, not as ammonia, but presumably in combination in some organic compound.

5. 100 c.c. of the sample were heated with a little free sulphuric acid, and a standard solution of potassium permanganate added till the liquid ceased to decolourise it, to find the amount of oxygen required to oxidise any matters capable of oxidation by such means.

The following determinations were made in the original water:—

Chlorine.—This was estimated by standard nitrate of silver solution.

Sulphuric Acid was determined by the usual gravimetric process.

Potash was weighed as potassium plato-chloride, the platinum being added after the sulphuric acid had been separated by baryta water, the baryta with milk of lime, and the lime with ammonium carbonate and a little oxalate.

Magnesia was determined and weighed as magnesium pyrophosphate.

The free carbonic dioxide and that in combination with ammonia were estimated together by boiling 200 c.c. of the water in a flask and passing the distillate through a refrigerated apparatus and directly into a solution of barium chloride and ammonia, the resulting precipitate of barium carbonate was washed, dried, gently ignited, and weighed.

The *total quantity* of carbonic acid in the water was determined by treating 50 c.c. of the sample with an ammonia solution of barium chloride, and drying the resulting precipitate of barium sulphate and carbonate, placing it in a carbonic acid apparatus, and expelling the carbonic dioxide by means of sulphuric acid, and determining its amount by loss.

I may say that each result herein given was repeated two, three, or more times, so as to leave little or no doubt as to its accuracy.

The table below gives the results of this analysis.

The water contained a large proportion of sodium salts. This base, however, was not estimated directly, the excess of acids being calculated as having been combined with that base.

	Grains.		Grs. per Gall.
1. Solid matter left on evaporating 4000 grs. of the sample to dryness and *heating* at 220° F. till the residue ceased to lose weight	111·972	= Total solid matter	1959·510
2. Weight of residue after prolonged heating to redness	111·898	= Loss on ignition	1·295
	Grammes.		
3. Loss by treating the precipitate of barium sulphate and carbonate produced from 50 c.c. of the sample, with sulphuric acid and water in carbonic acid apparatus	0·2655	= Total carbonic dioxide	371·700
4. Weight of the gently-ignited precipitate of barium carbonate produced from the distillation of 200 c.c. of the sample	2·7612	= Carbonic dioxide, free, and in combination with ammonia	215·995
5. Ammonia (NH_3) obtained by distilling 5 c.c. of the sample with 245 c.c. of pure water and "nesslerising"	0·00575	= Ammonia in combination with carbonic dioxide	80·500
6. Ammonia (NH_3) by distilling the liquid left in the retort from No. 5 with sodium carbonate and "nesslerising"	0·00010	= Ammonia presumably in combination with hydrochloric acid	1·400
7. Ammonia (NH_3) obtained by distilling the liquid left in the retort from No. 6 with potassium permanganate and "nesslerising"	0·0000325	= Nitrogen, presumably in combination in some organic compound	0·374
Weight of ignited precipitate of magnesium pyrophosphate from 50 c.c. of the sample	0·0928	= Magnesium	27·964
Weight of dried precipitate of potassium plato-chloride from 25 c.c. of the sample	1·2053	= Potassium	539·840
Weight of ignited precipitate of barium sulphate from 50 c.c. of the sample	1·3286	= Sulphuric anhydride	638·640
50 c.c. of the sample required 27·2 c.c. of standard silver nitrate solution (each c.c. of st. solution is precipitated by 0·006306 grms. pure sodium chloride) = weight of sodium chloride	0·17152	= Chlorine	145·719
100 c.c. of the sample required 9 c.c. standard potassium permanganate solution. Each grm. of oxalic acid required 550 c.c. of the st. solution to oxidise it = weight of oxalic acid	0·01636	= Oxygen required to oxidise matters existing in the sample	1·454
		Nitrates and nitrites	Absent

A series of experiments were made as follows to decide how these bases and acids were combined :—

1. Saturated solutions of pure ammonium chloride and potassium sulphate were prepared and mixed together, an excess of the chloride in each experiment being used. Alcohol was then added, and the resulting precipitate of sulphate washed with alcohol till free from chlorides.

2. Saturated solutions of pure ammonium sulphate and potassium chloride were mixed together, and the resulting sulphate precipitates freed from chlorides, as above mentioned. The sulphate in each of the two above-mentioned cases was found to be *potassium sulphate*.

3. The same experiments were made with sodium chloride and potassium sulphate on the one hand, and sodium sulphate and potassium chloride on the other, and the resulting sulphate in both cases found to be *potassium sulphate*.

4. The same experiments were made with ammonium sulphate and sodium chloride on the one hand, and ammonium chloride and sodium sulphate on the other. The resulting sulphate in both cases being *sodium sulphate*.

5. The same experiment was made with sodium carbonate and potassium sulphate on the one hand, and sodium sulphate and potassium carbonate on the other. The resulting sulphate in both cases being *potassium sulphate*

Part of the magnesium carbonate being precipitated by boiling some of the liquid under examination, left no doubt as to the form in which it existed in the solution.

From these data I have arranged the analysis of the sample of drainage liquid as follows :—

	Grains per Gallon.
Total solid matter	1959·510
Organic matter, combined water, &c.	1·295
Fixed saline matter	1958·215

The fixed saline matter is composed of—

Magnesium carbonate	97·874
Sodium carbonate	251·598
Potassium sulphate	1202·559
Sodium sulphate	153·566
Sodium chloride	235·311
Nitrates and nitrites	Absent
Loss	17·307
	1958·215

The following gives the proportions of free carbonic dioxide and volatile saline manners :—

	Grains per Gallon.
Free carbonic dioxide	17·110
Ammonium sesqui-carbonate	279·380
Ammonium chloride	4·406
Nitrogen, presumably existing in combination in some organic compound	0·370
Oxygen required by potassium permanganate test	1·454

There are many remarkable points about this drainage water.

First.—Although it comes directly filtering from what originally was most noxious organic matter, it is undoubtedly free from any of those substances, of which albumen may be taken as a type.

Second.—That all these organic matters have been practically completely decomposed by oxidation into carbonic acid, water, and ammonia, and the drainage remains charged with enormous quantities of these products. An idea of the quantity of carbonic dioxide present may be had by saying that 100 c.c. of the water contains 268·54 c.c. of this gas when measured at 0° C. and under a pressure of 760 m.m. of mercury.

Third.—That, although the oxidation of the organic matter had been so complete, yet the water was free from any trace of nitrates or nitrites.

Fourth.—That the water was free from any trace of ime or phosphoric acid, but contained a comparatively arge proportion of magnesium carbonate, which was kept in solution by the ammonium salts and free carbonic acid; the presence of this magnesium salt would no doubt account for the absence of phosphoric acid.

Fifth.—The sediment and solution are practically free from bacteria or other animalculæ.

Sixth.—That when the residue from a large proportion of the water is heated to redness it produces no charring or smell.

It might be interesting here to compare a few of the results of this analysis with those from a water which I collected about the same time which drained during a heavy rain from decomposing animal matter, principally butchers' offal, which had not been treated with charcoal. It contained—

Drainage from Animal Matter without Charcoal.

	Grains per Gallon.
Total solid matter left on evaporating to dryness and heating at 220° F. till it ceased to lose weight	272·335
Matter lost by prolonged heating to redness	118·475
Saline matter	153·860
Free ammonia	15·447
Chlorine	13·394
Oxygen required by potassium permanganate test	85·629

When the dry residue was heated to redness it emitted a very bad smell at first, and afterwards the smell of burning hair.

Microscopic examination showed abundance of animalculæ swimming about in all directions.

The charcoal with which the night-soil had been mixed deserves some notice. It was that produced in the manufacture of prussiate of potash by the charring of animal refuse, such as hoofs, hair, leather, woollen rags, &c., so that, although it is really "animal charcoal," it differs very much from the substance usually known under that name, viz., that obtained by heating bones to a red heat in closed vessels. It appears to have a powerful effect in absorbing and oxidising noxious gases, probably greater than any other species of charcoal. I have read an interesting lecture, given by Dr. Stenhouse, of London, many years ago, which was kindly placed in my hands by our worthy President, Mr. Binney. He made some experiments to decide the value of different charcoals, and came to the conclusion that animal, more properly speaking bone charcoal, was best adapted for absorbing colour from liquids, but wood charcoal was best adapted for absorbing noxious gases; he, however, draws a distinct line between the capabilities of a charcoal to simply absorb, on the one hand, and to absorb and then oxidise or decompose noxious gases on the other; but he does not mention the results of any experiments made with the charcoal under consideration. The following analysis of this substance was made and given to me by Mr. Spiegel, of Oldham :—

	Per cent.
Water	30·510
Organic and volatile matters	4·520 *
Carbon	22·790 *
Sand and insoluble matter	16·300
Oxide of iron and alumina	12·660
Lime	2·110
Magnesia	0·500
Sulphuric acid	5·330
Potash	3·117
Soda	0·759
Ferrocyanic acid	0·315†
Traces of phosphoric acid, carbonic acid, and loss	1·059
	100·000

* Containing nitrogen = ammonia 1·035

† Existing as Prussian blue.

In conclusion I have to thank Mr. Ralph Clifton, of Stockport, for the care and manipulative skill which he has shown in making the analysis of the sample of drainage water.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

February 26th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

PROF. C. LIEBERMANN and F. SCHWARZER described some "*Additive Compounds derived from Anthracen and the Halogens.*" These additive compounds crystallise well, and are colourless, while the substituted halogen derivatives are coloured. Dichloro-anthracen-dibromide, $C_{14}H_8Cl_2Br_2$, crystallises in long needles, and yields upon heating hydrobromic acid, dichloro-bromo-anthracen, $C_{14}H_7Cl_2Br$, and dichloro-dibromo-anthracen,—

$$C_{18}H_6Cl_2Br_2.$$

Dichloro-anthracen-dichloride, $C_{14}H_8Cl_2Cl_2$, is obtained by leading chlorine through a solution of anthracen in chloroform. The colourless crystals possess strong doubly refractive properties, and easily decompose with the formation of HCl. By melting fine crystals of trichloro-anthracen, $C_{14}H_7Cl_3$, are obtained. Treatment with alcoholic potash does not yield KCl and $C_{14}H_7Cl_3$, as might be expected, but changes the compound quantitatively into anthraquinon.

Dr. BIEDERMANN remarked that in the course of recent experiments he had been unable to obtain similar crystalline addition compounds from phenanthen.

F. TIEMANN aad B. MENDELSOHN described some "*Derivatives of Vanillic Acid*" isomeric with the acids obtained from narcotin by oxidation. Aldehydo-vanillic acid, $C_6H_2(COOH)(OCH_3)(OH)(COH)$, was changed by treatment with CH_3I into—

$$C_6H_2(COOH)(OCH_3)(OCH_3)(COH),$$

isomeric with opianic acid, and this body by oxidation into—

$$C_6H_2(COOH)(OCH_3)(OCH_3)(COOH),$$

isomeric with hemipinic acid. The new isopianic acid differs from opianic acid (melting-point 140°) in melting at 208°, yielding the peculiar reactions of derivatives of salicylic acid, and not producing meconin by oxidation. The iso-hemipinic acid melts at 246°, 66° above hemipinic acid. This difference in the isomers prepared synthetically from vanillic acid and those obtained from narcotin is in full harmony with the researches of Beckett and Wright (*Journ. Chem. Soc.*, March, 1876) upon the structure of opianic acid and hemipinic acid, as well as with those of the authors upon the structure of vanillic acid. They regard the arrangement of the substituted groups, $COOH.OCH_3.OCH_3.COOH$—1, 3, 4, 5—as consistent with all the reactions of the new compounds.

W. KLOBUKOWSKI has obtained "*Penta-brom-azo-naphthalin*," $C_{20}H_9Br_5N_2$, by the action of bromine upon azo-naphthalin in the presence of iodine. Bromine alone produces easily decomposed compounds. The new compound is insoluble in most solvents, and is deposited upon sublimation in the form of orange-coloured needles, not melting under 320°. It is obtained also by heating azo-naphthalin with an excess of bromine at a temperature of 260°. The azo-naphthalin used was obtained by the distillation of nitro-naphthalin with zinc-dust. The author finds the best solvent for purposes of crystallisation to be glacial acetic acid containing a few drops of fuming nitric acid. Experiments upon azo-naphthalin with fuming nitric acid alone, and in combination with sulphuric acid, gave no satisfactory results.

A. MICHAEL and S. GABRIEL describe a "*Phthalyl-tic Acid*" obtained by the action of acetic anhydride and anhydrous acetate of sodium upon phthalic anhydride. The reaction is as follows :—

$$C_6H_4(CO)_2O+(CH_3.CO)_2O=$$
$$=C_6H_4(CO)_2.CH.COOH+CH_3COOH.$$

The mixrure is heated together for nearly an hour, and then treated with warm water. The yellow crystals of the new acid, which separate out on cooling, are insoluble in pure water, easily crystallised from alcohol, and melt at 241°, under partial decomposition.

Prof. A. W. HOFMANN points out the existence of a series of "*Guanidin Sulpho-Acids*," the formation of which is analogous to that of the bases from which the guanidins are obtained. The reaction was particularly illustrated with diphenyl-guanidin. When this is submitted to the action of water or dilute acids the following decomposition takes place :—

$$C(C_6H_5)_2H_3N_3+2H_2O=CO_2+2C_6H_5NH_2+NH_2.$$

In the presence of concentrated H_2SO_4 the aniline is converted at once into sulphanilic acid, $C_6H_4(HSO_3)NH_2$. By exposing the mixture of diphenyl-guanidin and H_2SO_4 to a moderate heat no CO_2 is evolved, and the guanidin disappears in the liquid, from which a new sulpho.acid. $C(C_6H_4SO_3H)_2H_3N_3$, is obtained. The Ba, Pb, and Ag salts were described. Other guanidins were found to exhibit a perfectly analogous deportment. Experiments have been especially made with triphenyl-guanidin and the base obtained by the action of CCl_4 upon aniline.

In a late communication to the Society (CHEM. NEWS, vol. xxxv., p. 85) A. Kern stated that monomethyl-aniline was not formed by the action of CH_3I on $C_6H_5NH_2$, and doubted the existence of the compound on strength of his experiments. Prof. Hofmann read in this connection a paper from P. HEPP, "*On Mono-methyl Aniline*," which he has obtained by submitting the sodium derivative of acetanilid to the action of iodide of methyl. The compound thus prepared possesses exactly the same properties (boiling at 192°, &c.) which Prof. Hofmann has observed in mono-methyl aniline separated in large quantities from commercial aniline by the action of chloride of acetyl.

The following communications have been received from non-resident members :—

V. MEYER, "*On the Molecular Constitution of Ammonium Chloride.*" A. Ladenburg has recently defended the theory of the trivalence of nitrogen, and the correctness of the formula $NH_3.HCl$, by a comparison of the two bodies $N(C_2H_5)_3C_7H_7I$ and $NC_7H_7(C_2H_5)_2C_2H_5I$, obtained respectively from triethylamin with benzyl-iodide, and benzyl-diethyl amine with ethyl-iodide. These two bodies he regarded as essentially different, the first by treatment with HI yielding C_7H_7I; the latter, not Meyer, has repeated the experiments, and found the two bodies to be identical. The separation of C_7H_7I, in the one case, he considers to be due to the presence of small portions of $(C_7H_7)_2(C_2H_5)_2NI$, which is always formed in the process, and loses benzyl iodide easily; and he regards the two bodies as additional proofs for the formula NH_4Cl of the typical ammonium chloride.

A. BEHR has examined "*The Organic Acids present in the Juice of the Sugar-Cane.*" In addition to malic acid and oxalic acid, the only two acids previously detected, he has found aconitic acid, forming 0·149 per cent of the crude melago sugar obtained by simply boiling the juice of the sugar-cane. It is separated out in a pure state by treatment with acetate of lead and H_2S, followed by repeated crystallisations in the form of the ammonium salt. The turbidity of the aqueous solution of melago sugar was found to be due to the presence of aconate of lime, and simply by treatment with water large quantities of the acid can be obtained. Aconitic acid, $C_6H_6O_6$, appears to bear the same relation to the juice of the sugar-cane that citric acid—also a hexacarbon acid—does to the juice of the sugar-beet. The melting-point of the author's acid being 172°, and that given in chemical works being 140°, he was led to investigate this subject, and found the

melting-point of aconitic acid various, according to the method of preparation, but that in all cases it lies near 170°.

A. CHRISTOMANOS, "*On Chromic Iron Ore.*" The formula of Rammelsberg, $R_3O_4 = FeO,Cr_2O_3$, has been found correct for most specimens occurring in Greece. Other proportions have, however, been found—Cr_2O_3 : FeO, 1 : 1, 1 : 2, 2 : 3, 3 : 2.

T. HAVER DROEZE contributes an extensive array of experiments "*On the Solubility of Gypsum in Water and Various Saline Solutions.*" The results obtained with water coincide more closely with those published by Marignac than with those of other observers. Gypsum is, in general, more soluble in saline solutions than in water. In a solution of $MgSO_4$ it is, however, completely insoluble.

O. N. WITT describes his discovery of the "*Chrysoidin*," lately investigated by A. W. Hofmann (CHEMICAL NEWS, vol. xxxv., p. 64).

R. ANSCHUTZ finds that by the "*Action of Acetyl-Chloride upon Dibasic Acids*," instead of mixed anhydrides, acetic acid and the anhydride of the acid used are formed.

R. ANSCHUTZ and G. SCHULTZ, "*Action of Sodium Amalgam upon Phenanthren-quinon.*" By the action of hydrogen *in statu nascendi* on an alcoholic solution of phenanthren-quinon, reduction and oxidation take place at the same time, forming diphenyl-carbonic acid,—

$$COOH.C_6H_4-C_6H_4COOH.$$

H. BECKERTS and R. OTTO, "*A Simple Method of Preparing Propionic Acid from Propionitril.*" This consists in treating propionitril at 100° with three times its weight of a mixture of 3 vols. H_2SO_4 and 2 vols. H_2O. At the expiration of about two hours the reaction is ended, and the nitril changed almost quantitatively into propionic acid, which forms the upper layer of the liquid, and can easily be separated and purified. The method is preferable to that of treatment with HKO, &c., hitherto in use, on account of its rapidity, and it can be used for the production from their nitriles of such acids as cannot exist in an alkaline liquid.

"*On Solid Dichloro-propionitril.*" The authors have previously expressed the opinion that the solid dichloro-propionitril formed contemporaneously with the liquid α-dichloro-propionitril by the action of chlorine upon propionitril is a polymeric modification of the α compound. This assumption is supported by two experiments. If the solid dichloro-propionitril is heated with dilute H_2SO_4 it changes almost entirely into the liquid form. The proportion of the solid compound obtained in the joint preparation of the two is heightened by decreasing the temperature.

"*On the Preparation of Monochloracrylic Acid and Pyro-racemic Acid from α-Dichloro-propionic Acid.*" The silver salt of the latter yields, upon heating with water, a solution of monochloracrylic acid,—

$$C_3H_3Cl_2AgO_2 = C_3H_3ClO_2 + AgCl,$$

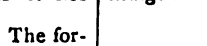
If Ag_2O or Ag_2CO_3 be added to this solution in the proportion of ½ mol. to 1 mol. of the acid silver monochloracrylate is formed, and this upon heating yields pyro-racemic acid, $C_3H_2ClAgO_2 + H_2O = AgCl + C_3H_4O_3$. This acid is also obtained directly from α-dichloro-propionic acid, $C_3H_4Cl_2O_2 + Ag_2CO_3 = C_3H_4O_3 + 2AgCl + CO_2$.

C. BÖTTINGER, "*On the Dry Distillation of Glycerinic Acid.*" Pyro-racemic acid is obtained in such very small quantities by this operation that the reaction cannot be used to explain the structural formula of the acid. A new acid, $C_4H_5O_3$, melting at 83°, and possessing striking crystalline properties, was found in small quantities in the distillate.

"*On Indigo.*" In the preparation of anthranilic acid from indigo formic acid was found to be the only other well characterised body yielded by the reaction, in accordance with the formula—

$$C_8H_5NO + O + 2H_2O = C_7H_5(NH_2)O_2 + CH_2O_2.$$

As this would tend to show that the eighth carbon atom in indigo is joined to hydrogen, the authors regard the reaction as being in favour of the following formula for indigo :—



Ortho-amido-benzoic aldehyd and formic acid,—

$$C_6H_4(NH_2)(COH) \text{ and } CH_2O_2,$$

could then be regarded as the most probable generators of indigo.

F. BEILSTEIN and A. KURBATOW, "*On the Chlorine Derivatives of Benzene.*" The authors have succeeded in obtaining the third isomeric trichloro-benzene, and the third isomeric tetrachloro-benzene wanting to complete the list of all possible chlorine derivatives of benzene according to the theory of Kekulé. Trichloro-benzene (1, 2, 3) is obtained by the action of ethyl-nitrite on p-m-o-trichlor-aniline (melting-point 67·5°). It crystallises in large laminæ from alcohol, melts at 54°, and boils at 219°. The nitro-derivative, $C_6H_2Cl_3NO_2$ (1, 2, 3, 4), crystallises in lustrous needles, melts at 56°, and yields by reduction the original trichloraniline. Tetrachloro-benzene (1, 2, 3, 4) is obtained from the above-mentioned trichloraniline by replacing the amido group by a chlorine atom. It crystallises in needles, melts at 46°, and boils at 245° to 253°. The nitro-compound is changed by reduction into tetrachlor-aniline, melting at 118°.

J. STENHOUSE and C. E. GROVES, "*On Dinitroso-orcin and Dinitro-orcin,*" (See CHEM. NEWS, vol. xxxv., p. 35.)

A. FITZ describes an extensive series of experiments "*On Schizomycetic Fermentation.*" A trace of this ferment causes in dilute aqueous solutions of glycerin, in the presence of $CaCO_3$ at 40°, a vigorous fermentation, producing chiefly, besides CO_2 and H_2O, ethyl-alcohol, normal butyl-alcohol, normal butyric acid, and caproic acid. Sulphate and phosphate of ammonia were found to give good results as sources of nitrogenous nourishment. By use of pepsin for this purpose a volatile base of the picolin series was obtained in small quantities. Mannite yields by the same fermentation normal butyl alcohol, normal butyric acid, and small quantities of succinic acid. Dextrin and starch yield with this process small quantities of alcohol.

CORRESPONDENCE.

CHEMICAL ANALYSIS FOR THE LOCAL GOVERNMENT BOARD.

To the Editor of the Chemical News.

SIR,—The Local Government Board has recently communicated to the Town Clerk of a northern town that when it engages a chemist to make an analysis of water it pays him three guineas for the analysis ; the analyses concerning which this communication was made being of a very elaborate kind, viz., complete analyses of the mineral matter in the water, in addition to the routine work—such analyses as chemists usually charge ten guineas for.

I trouble you with this letter in order that chemists may be warned that, unless they exact their fees beforehand, they will run great risk of being defrauded by the Local Government Board of that to which they are justly entitled.—I am, &c.,

J. ALFRED WANKLYN.

March 7, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 8, February 19, 1877.

Remarks by M. Chevreul in reference to a Paper on the Phosphorescence of Organic Bodies by M. B. Radziszewski.—The author calls attention to his

memoir "On the Simultaneous Action of Gaseous Oxygen and of Alkalies upon a Great Number of Organic Bodies," read before the Academy of Sciences August 23, 1824.

Manufacture of Carbon Conductors for the Electric Light.—M. F. Carré.—The author saturates charcoal with solutions of certain salts, and finds that potash and soda double the length of the electric arc, and augment the light in the proportion of 1 to 1·25. Lime, magnesia, and strontia increase the light to 1·30 to 1·50; iron and manganese to 1·60 to 1·70. Boracic acid increases the durability of the carbon, but does not improve the light. The saturation of pure regularly porous charcoal with the solutions of different bodies is a convenient and economical method of producing their spectra, but it is preferable to mix the simple bodies with compound carbons.

Detection and Determination of the Principal Colouring Matters employed in the Sophistication of Wines.—M. G. Chancel.—The author takes 10 c.c. of wine, and adds 3 c.c. of a dilute solution of subacetate of lead, allowing the mixture to subside for a few minutes to make sure that the precipitation is complete. If this is not the case a slight excess of the reagent is added. After stirring and heating for a few moments it is thrown on a very small filter, the filtrate collected in a test-tube, and the precipitate washed three or four times in hot water. If the filtrate is coloured magenta is present, and may be sought for by the aid of the spectroscope. But if the wine contains a mere trace of this colour it is retained in the precipitate, and is sought for in the manner directed below. To discover the colouring matters which may be contained in the plumbic precipitate, it is treated upon the filter with a few c.c. of a solution of carbonate of potassa (2 parts of the dry salt to 100 of water), taking care to repass *the same solution* several times through the precipitate. Any magenta present is thus extracted, along with carminamic (ammoniacal cochineal) and sulphindigotic acid. The colouring matters of logwood and of alkanet remain undissolved. With a genuine wine the alkaline liquid takes a very faint yellow or greenish yellow tint. For the detection of magenta the filtrate is mixed with a few drops of acetic acid, and it is then shaken up with amylic alcohol. The magenta dissolves in this alcohol with a fine rose tint, and its presence is proved by spectroscopic examination. Carminamic and sulphindigotic acids remain in the aqueous solution, and are decanted off. A couple of drops of sulphuric acid are added, and the mixture is again shaken up with amylic alcohol, which now dissolves the ammoniacal cochineal. It may be detected by the spectroscope. The sulphindigotic acid remains undissolved in the amylic alcohol, and may be found in the blue aqueous residual liquor by means of the spectroscope. Logwood is most conveniently sought for in a fresh portion of the wine by digestion with a little precipitated carbonate of lime, adding a few drops of lime-water, and filtering. In a natural wine the filtrate has a faint greenish yellow colour, but if logwood is present it takes a fine red shade, and the absorption-bands of logwood may be detected with the spectroscope. On treating the lead precipitate above mentioned with an alkaline sulphide, washing with boiling water, and then treating with alcohol, in which alkanet, if present, is detected by spectroscopic examination.

Action of Alkaline Sulphocyanides on the Hydrochlorates of the Alkalies of the Fatty Series.—P. De Clermont.—The double decomposition between sulphocyanide and hydrochlorate of aniline determines a molecular change which gives rise to sulph-urea.

Action of Electrolytic Oxygen upon Glycol.—M. A. Renard.—Not suited for abstraction.

Localisation of Copper in the Organism after Ingestion of a Salt of this Metal.—M. Rabuteau.—In this case a woman in the course of 122 days had taken 43 grms. of ammoniacal sulphate of copper. Three months after the last dose she died of rapid tuberculosis. The liver, weighing 1474 grms., contained only 23·95 centigrms.

Buds of the Vine as a Material for Paper Making.—M. Boutin.—An industrial suggestion.

MEETINGS FOR THE WEEK.

MONDAY, 12th.—London Institution, 5.
—— Medical, 8.
—— London Institution, 5.
—— Society of Arts, 8. (Cantor Lectures). "Chemistry of Gas Manufacture," A. Vernon Harcourt, F.R.S.
TUESDAY, 13th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8.
—— Photographic, 8.
—— Society of Arts, 8, "Our Commercial Relations with West Africa, and their Effects upon Civilisation," by James Irvine.
WEDNESDAY, 14th.—Society of Arts, 8. "The Treatment of Town Refuse and Sewage," Prof. Ansted, F.R.S.
THURSDAY, 15th.—Royal, 8.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Chemical, 8. "Note on a Method of Estimating Bismuth Volumetrically," by M. M. P. Muir. "Note on Gardenine," by Dr. Stenhouse and Mr. Groves. "Preparation of Copper-Zinc Couples," by Dr. Gladstone and Mr. Tribe. "On Chromium Pig-Iron," by E. Riley.
—— London Institution, 7.
—— Royal Society Club, 6.30.
—— Society of Arts, 8. (Indian Section). "The Native Indian Press," Dr. G. Birdwood, C.S.I.
FRIDAY, 16th.—Royal Institution, 9. "Armenia and Ararat," Dr. J. Bryce.
SATURDAY, 17th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."
—— Physical, 3. "On some Points which have a Bearing on the Theory of the Photographic Image," by Capt. Abney, F.R.S. "On a Modification of Mance's Method of Measuring the Resistance of Batteries, &c.," by O. J. Lodge, B.Sc. "Certain Experiments with a large Induction Coil," by W. Spottiswoode, F.R.S.

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MANCHESTER CORPORATION GAS-WORKS.—TO TAR DISTILLERS AND OTHERS.—The Gas Committee are prepared to RECEIVE TENDERS for the Purchase of the Whole or Portion of the GAS-TAR to be produced at their Gaythorn and Rochdale Road Works for the term of one or more years, as may be agreed upon, commencing on the 1st day of March, 1878. The total quantity that will be produced during the first year is estimated at 15,000 tons or thereabouts. Sealed tenders, addressed to the Chairman of the Gas Committee, Town Hall, and endorsed "Tender for Gas-Tar," must be delivered at this office on or before the 20th day of March next. The Committee do not bind themselves to accept the highest or any tender.—Further particulars as to conditions of contract and forms of tender may be obtained on application to Mr. Jackson, at the Gas Office.—By order of the Gas Committee.

JOSEPH HERON, Town Clerk.

Gas Office, Town Hall, Manchester, 27th January, 1877.

THE CHEMICAL NEWS.

VOL. XXXV. No. 903.

ON THE ESTIMATION OF CHROMIUM IN CHROMATE OF IRON ($FeO.Cr_2O_3$).

By SERGIUS KERN, St. Petersburg.

CHROMIUM compounds are much employed in the arts as pigments possessing bright colours. The chief ore from which chromium compounds are obtained is chrome ironstone or chromate of iron. This ore is analysed in nearly all cases by Dr. Clark's titration method, giving very accurate results. A quick method used by me for the estimation of chromium also gives good results, and may be thus described:—0·5 grm. of well-washed powdered mineral is fused with acid potassium sulphate ($KHSO_4$); the resulting mass is powdered and dissolved in nitric acid with the addition of a small quantity of potassium chlorate. The solution is filtered from the silica and other insoluble matter, and ammonium disulphide (NH_4HS) is next added in order to precipitate the iron in the form of sulphide, and the chromium in the form of hydrated chromium oxide. The precipitate is filtered from the liquor, dried, and ignited till all the fused mass shines with a bright white light. The resulting mass is powdered and dissolved in strong hydrochloric acid. The iron compound dissolves, leaving the anhydrous chromium oxide in the form of a precipitate, which is washed, dried, and weighed.

The following experiments were made in order to know the accuracy of this method:—

1. *Estimation of Chromium by Titration.*—0·5 grm. of iron chromate (No. I.) gave 0·320 grm. of Cr_2O_3, equal to 20·6 per cent of Cr; 0·5 grm. of iron chromate (No. II.) gave 0·200 grm. of Cr_2O_3, equal to 12·8 per cent of Cr; 0·5 grm. of iron chromate (No. III.) gave 0·080 grm. of Cr_2O_3, equal to 5·2 per cent of Cr.

2. *Estimation of Chromium by the Method Mentioned above.*—0 5 grm. of iron chromate (No. I.) gave 0·319 grm. of Cr_2O_3, equal to 20·5 per of Cr; 0·5 grm. of iron chromate (No. II.) gave 0·199 grm. of Cr_2O_3, equal to 12·8 per cent of Cr; 0·5 grm. of iron chromate (No. III.) gave 0·076 grm. of Cr_2O_3, equal to 4·89 per cent of Cr.

These experiments prove that in some cases the method proposed may be used in analysing the iron chromate.

Obouchoff Steel Works, St. Petersburg.

RESEARCHES ON THE SPECTRA OF METALS AT THE BASE OF FLAMES.

By M. GOUY.

IT is known that a flame produced by a mixture of coal-gas and air in suitable proportions, so as to burn without the aid of the external air, has for a base an interior cone, on the surface of which combustion begins. This surface is brilliant, of a blue or green colour, and gives the spectrum of carbon. The experiments that I have to report show that this same surface gives a spectrum very different from that of the flame of which it forms the base, when the combustible mixture holds in suspension saline powders. The solutions are pulverised by a jet of compressed air; the air charged with spray enters a regulator, where also arrives coal-gas, and from whence issues a mixture of constant composition. This mixture enters a vertical tube, of 19 m.m. in diameter, capped with a gauze of iron-wire, above which it burns with a conical flame of from 6 to 8 c.m. The height of the interior cone varies from 3 or 4 c.m. to zero, and the flame may be rendered oxidising or reducing at pleasure.

By means of a lens we project on the slit of the spectroscope the image of the flame. We then see two spectra one above the other; the lower one is produced by the light of the blue surface, and all the rays which compose it are cut off exactly at the same height; the other is produced by the flame, properly speaking, and the rays which are peculiar to it encroach on the lower spectrum by reason of the form of this flame.

When the apparatus is worked empty, the lower spectrum shows brilliantly the rays of carbon. If a solution of chloride of lithium is pulverised, the following facts are observed:—The upper spectrum shows a red ray, very vivid, and a feeble ray in the orange. The first appears equally brilliant in all its height; the other, at the point where it penetrates into the lower spectrum, becomes more vivid. Besides, the lower spectrum shows clearly a blue ray (γ of the electric spectrum), which terminates at the same height as the rays of carbon, and is wanting in the upper spectrum. We find these characters with other metals:—

Sulphate of Thallium.—It gives its characteristic green ray, which is distinctly strengthened in penetrating the lower spectrum.

Chloride of Calcium.—The upper spectrum is deprived of the rays peculiar to the undecomposed chloride. The blue ray is strengthened a little in penetrating the second spectrum.

Chloride of Strontium.—The upper spectrum offers nothing in particular; the lower shows three faint blue rays, which belong to the electric spectrum of strontium.

Chloride of Barium.—The rays and bands of the upper spectrum are strengthened on penetrating the other, especially the brilliant green ray.

Chloride of Manganese.—The upper spectrum shows traces of the rays α and γ of the electric spectrum: this latter is more visible when the flame is oxidising. The lower spectrum gives brilliantly the ray α quite near to the green ray of carbon. This ray is triple in the electric spectrum; I have only been able to see one of its components, the other no doubt being confounded with the carbon ray. Of these two components, the most brilliant is as much so as the carbon ray; and, as it is very near, we may ascertain that they have exactly the same height. The ray γ is not strengthened in the lower spectrum.

Chloride of Iron.—The flame is very luminous, of a greenish yellow. The upper spectrum is formed by two bands and fine rays, very numerous, on a continuous ground. The lower spectrum shows three groups of rays, very visible, which correspond to the groups of the electric spectrum β and ζ between green and blue, and γ in the violet.

Chloride of Cobalt.—The flame much resembles the former. The upper spectrum is formed by a very bright continuous illumination; the lower shows three faint rays in the violet and the extreme violet, γ, θ, and η of the electric spectrum.

Chloride of Zinc.—Nothing but faint continuous illumination in the upper spectrum; the lower shows the violet ray α of the electric spectrum very distinct.

Chloride of Cadmium.—Nothing in the upper spectrum; the other gives a faint violet ray, β of the electric spectrum.

Nitrate of Manganese.—The upper spectrum has nothing in particular; the lower shows a group of three faint violet rays, α of the electric spectrum.

Nitrate of Copper.—The upper spectrum shows several bands; one of them, in the red, is notably strengthened in the lower spectrum.

Nitrate of Lead.—Nothing in the upper spectrum; the other gives a very visible ray in the extreme violet, α of the electric spectrum.

Nitrate of Silver.—Nothing in the upper spectrum; the other shows two very marked rays, α and β of the electric spectrum.

Chloride of Platinum.—The flame is of a bluish white; it illuminates as well as a candle. The upper spectrum

shows a vivid continuous light, with some faint bands and rays. The lower spectrum does not resemble the electric spectrum; it is formed by a beautiful series of very brilliant bands, fading away on the side of the red, and sharply defined at the other extremity; we also see some more faint rays.

Amongst the other metals some have not been submitted to the experiment, and others have not given very definite results.

The spectra which we have just been describing have been observed with flames slightly reducing. In charging the flame with gas the interior cone grows longer, and its spectrum becomes less brilliant without changing its nature. With a large excess of air the cone changes its form, and is divided into violet points, sometimes very high; at this moment the carbon rays disappear, except that of the violet; they are replaced by a continuous ground, upon which are detached faint metallic rays. The flame, properly speaking, is almost invisible, and shows hardly any trace of the sodium ray, but it becomes visible and is coloured green when it contains copper.

To sum up, we see that the base of the flame gives, at a very small height, a spectrum which approaches the electric spectrum of the same metal; I propose to extend these researches to other flames. I shall remark, in concluding, that in ordinary spectral analysis we see a mixture of the two spectra of the cone and the flame: the relative intensity of the rays must therefore change according to the part of the flame which we examine, as M. Lecoq de Boisbaudran had observed for chloride of manganese.—*Comptes Rendus.*

SCHEELE'S GREEN:
ITS COMPOSITION AS USUALLY PREPARED AND SOME EXPERIMENTS UPON ARSENITE OF COPPER.*

By S. P. SHARPLES, S.B.

(Concluded from p. 92.)

Experiment No. 6.

	Molecules.
Copper sulphate	6
Sodic carbonate	3
Arsenic trioxide	1

The filtrate was blue and acid; the precipitate gave:—

Analysis No. XI.

	Per cents.	Atomic Ratios.
Copper oxide	60·80	7·66
Arsenic trioxide	14·53	0·73
Sulphur trioxide	13·34	1·67
Water	11·11	6·17

This corresponds with a mixture of tribasic arsenite and sulphate, with a little excess of copper oxide.

To the blue filtrate from the above, three molecules more of sodic carbonate were added, the filtrate was faint yellow, and free from copper, but contained arsenic; the precipitate contained a little carbonate.

Analysis No. XII.

	Per cents.	Atomic Ratios.
Copper oxide	56·71	7·14
Arsenic trioxide	28·62	1·44
Sulphur trioxide	1·59	0·20
Water	9·50	5·28
Carbon dioxide	3·35	0·77
	99·77	

These precipitates both dissolved in ammonia with a blue colour, and stood boiling without change of colour.

Experiment No. 7.

	Molecules.
Copper sulphate	6
Potassium carbonate	6
Arsenic trioxide	1

Boiled for half an hour, filtrate colourless, free from copper, but contained arsenic; precipitate did not blacken on boiling, was free from carbonates, but contained basic sulphate. Washed until filtrate was free from arsenic.

Analysis No. XIII.

	Per cents.	Atomic Ratios.
Copper oxide	58·85	7·41
Arsenic trioxide	27·08	1·37
Sulphur trioxide	4·83	0·60
Water	8·55	4·75
	99·30	

Experiment No. 8.

Scheele's original receipt is very nearly one part by weight of arsenic to three each of copper sulphate and potassium carbonate, and is frequently so given. The proportions as given by Scheele are, 11 ounces of the first, and 32 of each of the others. In molecules, supposing the potassium carbonate to be pure and anhydrous, as he directs it should be, the receipt will be as follows:—

As_2O_3	1·00
CuO	2·32
K_2CO_3	4·34

Or nearly double the amount of potassium carbonate required in the reaction—

$$CuSO_4 + K_2CO_3 = CuCO_3 + K_2SO_4.$$

A portion was therefore prepared, using—

	Parts.	Molecules.
Copper sulphate	6	2·35
Potassium carbonate	3	2·17
Arsenic trioxide	2	1·00

The filtrate was slightly acid and blue, but the potassium carbonate used not quite anhydrous. The colour produced was fully equal to that produced by the ordinary receipt. The filtrate contained arsenic.

Analysis No. XIV.

	Per cents.	Atomic Ratios.
Copper oxide	51·37	6·62
Arsenic trioxide	39·94	2·02
Sulphur trioxide	1·80	0·22
Water	6 61	3·67

This is almost an exact mixture of tribasic sulphate and arsenite. It dissolved in ammonia with a blue colour, and did not blacken on boiling. The potassium carbonate may, therefore, be considerably diminished from that called for in Scheele's receipt.

Experiment No. 9.

This was nearly a repetition of Experiment No. 4 as to quantities used. The object being in this case to study more fully the effects of washing, the proportions taken approximate closely to Scheele's receipt:—

	Parts.	Molecules.
Copper sulphate	3	2·35
Arsenic trioxide	1	1·00
Potassic carbonate	3	4·34

The solutions were mixed and boiled for half an hour; the first (No. XV.) was washed until the wash-water was free from sulphates; the other (No. XVI.) until the wash-water was free from arsenic.

Analysis No. XV.

	Per cents.	Atomic Ratios.
Copper oxide	52·23	6·60
Arsenic trioxide	35·41	1·79
Sulphur trioxide	5·88	0·74
Water	6·02	3·35
	99·54	

Analysis No. XVI.

	Per cents.	Atomic Ratios.
Copper oxide	57·18	7·20
Arsenic trioxide	25·62	1·30
Sulphur trioxide	6·31	0·79
Water	10 85	3·90

* Read before the American Academy of Arts and Sciences.

Experiment No. 10.

This preparation was made exactly according to Scheele's own directions, as given by himself in the *Proceedings of the Stockholm Academy*, using the English translation for the weights and measures. The sample was divided after precipitation. No. XVII. was washed by decantation with the amount of water he specifies.

No. XVIII. was first boiled with water, and then washed with hot water so long as arsenic was found in the filtrate. The proportions used were:—

	Parts.
Arsenic trioxide	11
Potassium carbonate	32

Dissolved the potassium carbonate in thirty-two parts of water, added the arsenic trioxide, boiled and filtered.

	Parts.
Copper sulphate crystallised ..	32
Water	192

Dissolved and boiled while hot; added, with constant stirring, the hot solution of arsenic trioxide.

ANALYSIS No. XVII.

	Per cents.	Atomic Ratios. Found.	Taken.
Copper oxide	50·76	3·10	2·32
Arsenic trioxide ..	40·82	1·00	1·00
Sulphur trioxide ..	1·63	0·10	—
Water	6·41	1·75	—
	99·62		

ANALYSIS No. XVIII.

	Per cents.	Atomic Ratios.
Copper oxide	49·25	6·20
Arsenic trioxide..	42·66	2·15
Sulphur trioxide	0·42	0·05
Water..	6·71	3·72
	99·04	

In summing up, I will first call attention to the fact that in no one of the eighteen samples does the arsenic exist in these compounds in as great a ratio as required by Bloxam's formula. Further, they all contain water, and this water is not driven off at a temperature of 150° C. In every case arsenic was found in the filtrate, sometimes in considerable amount, as is shown by comparison of the ratios of copper sulphate and arsenic trioxide taken, and the ratios between the copper oxide and arsenic, as found in the analysis. All the samples dissolved in ammonia with a blue colour.

In Experiments 4, 9, and 10 almost identical amounts of substances were taken; but the results, as will be seen, differ widely.

Scheele's green may, according to my experiments, be described as a more or less basic copper arsenite, which may or may not contain basic copper sulphate and carbonate; the composition of it seeming to depend to a considerable extent upon the degree of concentration of the liquid from which it is precipitated. Its basicity also seems to depend to a considerable extent upon the same fact, the more dilute the solution the more basic the salt.

The composition also depends, to some extent, on the amount of wash-water used in washing it.

The normal pigment which is represented by Analysis XVIII. may be described as follows:—

It is of a yellowish green colour, soluble in dilute acids and in caustic alkalies. It dissolves in alkalies with a blue colour, and is decomposed by excess of soda or potassa, or their carbonates, but is not decomposed by ammonia, even upon boiling. It does not blacken upon boiling with distilled water. When dissolved in ammonia, if a solution of soda or potash is added, the solution is bleached, from the reduction of the copper salt to a cuprous salt.

Its average composition, as generally prepared, omitting the sulphur trioxide which is generally found in it, is about as follows:—

Copper oxide	50·00
Arsenic trioxide	42·00
Water	8·00

This approximates closely to the formula—

$$Cu_3As_2O_62H_2O.$$

This formula would give the following percentages:—

Copper oxide	51·44
Arsenic trioxide	41·93
Water	7·93

Taking this view of the subject, Scheele's green is the normal tricupric arsenite, and corresponds to the triargentic arsenite described by Bloxam.

It is almost impossible, however, to obtain a perfectly constant product, from the strong tendency to form basic sulphates and basic arsenites.

As a matter of economy in the preparation, it will be found more advantageous to take the following proportions rather than those given by Scheele:—

	Parts.
Copper sulphate	6
Arsenic trioxide	2
Sodium carbonate, $Na_2CO_310H_2O$ ..	8

Dissolve the soda and arsenic in 10 parts of water, and the copper sulphate in 40 parts of water; filter both solutions if necessary. Mix while boiling, boil for a few minutes, and then allow to stand until next day; pour off the supernatant liquid, fill up the vessel with hot water; repeat this operation about three times, then filter, and dry at about 100° C.

In analysing these salts, the water was determined by ignition in a current of oxygen. The water being collected and weighed in a chloride of calcium tube. The arsenic was determined in various ways, but it was found that the conversion into arsenic pentoxide and trituration with uranium solution gave the most satisfactory results. The copper was determined with the battery.

The separation of copper and arsenic was made either by boiling with a slight excess of potassa with previous oxidation by nitric acid or bromine, or by adding potassa, and then passing hydrogen sulphide through the solution until the copper was completely precipitated.

My thanks are due to my assistant, E. R. Hills, for the able manner in which he has aided me by making many analyses of these salts—an undertaking that can be appreciated only by those who have tried working with copper and arsenic in combination.

Since the above paper was finished, I have succeeded in obtaining two samples of copper arsenite as found in commerce. The first of these resembled closely that analysed in Analysis No. XII. in colour, and on examination it was found to contain carbon dioxide and sulphur trioxide; the other resembled Analysis No. XVIII., and, like it, contained a trace of sulphate.

Analysis of China-Clays from Kin-Kiang, in China. —M. W. Kalmann.—

Silica (soluble)	0.501
Silica (insoluble)..	50·133
Alumina	32·737
Ferric oxide	0·955
Ferrous oxide	1·690
Manganous oxide	0·827
Lime	0·501
Magnesia	0·268
Potassa	2·520
Soda	traces
Loss on ignition	10·011
	100·146

—*Bull. de la Soc. Chim. de Paris.*

ANALYSES OF IRON ORES, LIMESTONES, COALS, &c., USED IN THE IRON MANUFACTURE IN SCOTLAND.

By WILLIAM WALLACE, PH.D., F.R.S.E., F.C.S., Public Analyst for Glasgow, &c.

(Continued from p. 51).

TABLE IV.—OCHREY IRON ORES, CHIEFLY SPANISH, USED IN BLAST-FURNACES IN SCOTLAND.

Constituents.	I. Bilbao.	II. Bilbao.	III. Santander.	IV. Santander.	V. Oran.	VI. Porman.	VII. Porman.	VIII. Tuscany.
Peroxide of Iron	72·00	71·53	84·33	81·14	71·00	67·42	67·43	80·00
Oxide of Manganese	2·08	2·42	1·08	1·64	—	0·66	1·44	1·80
Lime	0·33	1·48	trace	trace	11·09	2·44	2·72	1·79
Magnesia	0·22	0·22	0·24	0·59	1·73	trace	0·36	0·24
Carbonic Acid	0·45	1·40	0·26	0·65	10·61	1·13	1·30	1·67
Phosphoric Acid	0·06	trace	trace	trace	—	0·11	trace	0·04
Sulphuric Acid	—	—	—	—	—	1·23	0·83	—
Alumina	4·92	4·58	0·83	2·14	0·74	1·76	4·33	1·40
Silica	6·04	7·00	1·12	1·80	1·36	17·46	13·40	2·28
Combined Water	10·50	9·11	10·34	9·95	1·87	7·79	9·19	10·78
Water at 212° F.	3·40	2·26	1·80	2·09	1·60			
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Iron	50·40	50·07	59·03	56·80	49·70	47·20	47·20	56·00

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 6, 1877.

Rev. WILLIAM GASKELL, M.A., in the Chair.

"*On the Action of Water and Dilute Saline Solution upon Lead.*" Part III. By M. M. PATTISON MUIR, F.R.S.E., Assistant Lecturer on Chemistry, the Owens College.

1. In the second part of these researches (*Proc. Manch. Lit. and Phil. Soc.*, xvi., 1) I showed that there is generally an increase in the solvent action of water and dilute saline solutions upon lead when the experiments are carried out in beakers covered with porous paper; also that exposure of large surfaces of liquid to the surrounding atmosphere generally tends to increase solvent action. Further, my experiments led me to conclude that the solvent action tends to attain a maximum when the volume of liquid is large in proportion to the surface of lead exposed. I also concluded that under favourable conditions the quantity of lead dissolved increases in an increasing ratio with time during which the action is allowed to proceed. (Compare par. 6). Finally, I expressed my belief that the purity of the lead upon which the various liquids are allowed to act, very materially conditions the solvent action of those liquids.

In the present communication I propose to bring forward further experimental evidence as regards some of these points, and also to touch upon certain circumstances conditioning the solvent action of dilute saline solutions upon lead which have not as yet been studied.

2. And the first point which demands attention is one which I merely mentioned in my second paper, viz., Does the relation between surface of lead exposed and total quantity of liquid influence the solvent action? In the following experiments the surface of lead exposed was maintained constant, the strength of the saline solution was also unchanged, but the total quantity of liquid was increased. Otherwise the experiments were carried out under exactly similar conditions.

Sometimes a slight increase is noticed in the quantity of lead dissolved by equal quantities of solutions, when the total volume of liquid is increased; on the other hand a slight decrease is sometimes noticed. I think that so far as these experiments go, we may conclude that a very large volume of liquid dissolves no more lead than a relatively small volume, when caused to act on the same amount of metallic surface.

TABLE I.

EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH LIQUID (500 C.C. IN EACH) AND COVERED WITH UNSIZED PAPER: DIAMETER OF MOUTH OF BEAKER = 11·5 C.M.

Salt.	Grams per Litre.	Quantity of Liquid. c.c.	Lead exposed. sq. cm.	Lead Dissolved (Mgms.) per 500 c.c. liquid. 11 dys.	21 dys.
Ammonium nitrate	0·20	250	50	1·8	1·5
" "	0·20	500	50	2·5	2·5
" "	0·20	750	50	2·5	2·5
" "	0·20	1000	50	2·5	1·8
Potassium nitrate	0·20	250	50	2·5	1·8
" "	0·20	500	50	1·5	1·8
" "	0·20	750	50	1·3	1·3
" "	0·20	1000	50	1·0	1·0
Calcium chloride	0·20	500	50	2·5	3·5
" "	0·20	1500	50	1·3	2·0

3. The second question calling for an answer is—Does the quantity of lead dissolved increase with increase of time, or is there a maximum reached after which no further increase is noticeable?

Various experiments were carried out. Pieces of clean lead were immersed in different saline solutions for three months, and were then subjected to the action of various liquids. Comparable experiments, omitting the previous lengthened immersion in saline liquids, were also carried out. Special experiments in reference to potassium carbonate are detailed, inasmuch as in my last paper I had provisionally concluded that in the presence of this salt, the solvent action of water upon lead soon—comparatively speaking—reaches a maximum.

Fresh light is also thrown upon the question now under consideration by the results of experiments having for their special object a comparison of the solvent action of various liquids upon different samples of lead. (Par. 10.)

4. In order to compare these numbers with those obtained by submitting the same amount of surface of the same specimen of lead to the action of distilled water containing equal quantities of the same salts during the same intervals of time, I subjoin the following determinations taken from a paper already read before this Society (xvi., p. 3). The experiments were carried out under exactly similar conditions.

TABLE II.

LEAD IMMERSED IN STRONG SOLUTIONS OF THE UNDERMENTIONED SALTS FOR THREE MONTHS: THEN WASHED WITH A LITTLE DISTILLED WATER, AND IMMERSED IN VARIOUS SOLUTIONS.

EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH WATER (500 C.C. IN EACH) AND COVERED WITH UNSIZED PAPER: DIAMETER OF MOUTH OF BEAKER = 11·5 C.M.

A.—*Lead Immersed in Strong Solution of Potassium Carbonate.*

Then in—	Grams per Litre.	Surface of Lead exposed in sq. cm.	Total Lead, in Mgms., in Solution after— 6 dys.	15 dys.	38 dys.	62 dys.
Potassium carbonate	0·20	50	trace	trace	trace	trace
,, nitrate ..	0·20	50	0·40	1·00	1·00	1·20
Ammonium ,, ..	0·20	50	1·50	3·50	2·00	1·00

B.—*Lead Immersed in Strong Solution of Potassium Nitrate.*

Then in—						
Potassium carbonate	0·20	50	0·20	0·20	0·20	0·30
,, nitrate ..	0·20	50	0·30	0·30	0·20	0·30
Ammonium ,, ..	0·20	50	0·50	0·50	0·30	0·70

C.—*Lead Immersed in Strong Solution of Calcium Chloride.*

Then in—						
Potassium carbonate	0·20	50	0·20	0·20	0·20	0·50
,, nitrate ..	0·20	50	1·20	0·50	0·40	0·50
Ammonium ,, ..	0·20	50	2·50	0·80	0·60	0·80

D.—*Lead Immersed in Strong Solution of Ammonium Sulphate.*

Then in—						
Potassium carbonate	0·20	50	0·30	0·50	0·40	0·50
,, nitrate ..	0·20	50	3·00	3·00	1·90	1·80
Ammonium ,, ..	0·20	50	5·00	1·30	0·30	1·00

TABLE III.

Salt.	Grams per Litre.	Surface of Lead in sq. cm.	Total Lead in solution, in Mgms., after 18 days.
Potassium carbonate ..	0·20	50	0·3
,, nitrate ..	0·20	50	2·4
Ammonium ,, ..	0·20	50	3·8

In these experiments the lead had *not* been previously immersed in saline solutions.

5. The following experiments have especial reference to the action of time in determining the quantity of lead dissolved by a water containing potassium carbonate in solution.

TABLE IV.

EXPERIMENTS IN BEAKERS, CORKED FLASKS, AND BASINS, DETAILS OF MEASUREMENTS, &C., AS IN LAST PAPER (xvi., p. 3). IN EACH CASE 500 C.C. OF LIQUID CONTAINING 0·20 GRAMS OF POTASSIUM CARBONATE PER LITRE. 50 SQ. CM. OF SURFACE OF LEAD EXPOSED.

	Total Lead, in Mgms., in solution after— 8 days.	10 days.	12 days.	20 days.
Flask	0·20	0·20	0·20	0·20
Beaker	0·30	0·30	0·30	0·30
Basin	0·40	0·40	0·40	0·40

6. The results of these experiments are rather peculiar; they certainly show that the action upon lead of all the saline liquids with which I have experimented is an exceedingly complicated one, and that it is very difficult to separate one set of conditioning circumstances from all others.

In the case of potassium carbonate a maximum was reached so soon as at the end of eight days; after this time the quantity of lead in solution did not increase. If, however, the lead have been previously immersed in a solution of either potassium nitrate, calcium chloride, or ammonium sulphate, then the solvent action of the potassium carbonate solution continues to increase (at least, throughout so long a period as 62 days), although but to a very slight extent. Generally I conclude that the solvent action of saline solutions continues throughout very lengthened periods; certainly that it does so if the liquid be removed, and fresh liquid, holding the same or other salts in solution, be put in its place. In some cases, however, a maximum point appears to be reached after the expiry of 14 days or so, after which, if the liquid be undisturbed, little or no further solvent action occurs.

7. In some of these experiments a remarkable result is obtained, viz, the quantity of lead in solution is found to *decrease* after a certain point has been reached. In order to determine whether the same result could be obtained when the solvent liquids were not exposed to the air, the following experiments were carried out in corked flasks each containing 500 c.c. of water, the surface of lead exposed amounting as before to 50 sq. cm.

TABLE V.

Salt.	Grams per Litre.	Total Lead, in Mgms. dissolved after— 15 days.	32 days.	38 days.
Potassium carbonate ..	0·20	0·40	0·30	0·30
,, nitrate ..	0·20	0·90	0·70	0·60
Ammonium ,, ..	0·20	1·50	1·00	0·80

8. Here again we have a slight decrease in the solvent action of solutions of potassium and ammonium nitrates upon lead taking place after the expiry of lengthened periods. The lead would appear to be precipitated from solution after a time. A remarkable instance of such precipitation will be detailed in a future paragraph.

9. I must now consider the question of the purity of the lead itself as influencing the quantities of this metal dissolved by various liquids.

The experiments were carried out in flasks and beakers.

The sample of "pure" lead was found to contain very small traces of manganese, iron, and zinc; the "commercial" sample, No. I, contained small quantities of antimony and tin, very little iron, no manganese, copper, or bismuth, but traces of Aluminium; the impurities in No. II. sample were the same as in No. I., small quantities of copper being also present. The results are very startling. With No. I. sample of commercial lead, less lead was dissolved in almost every case than with "pure" lead; with No. II. sample, whose chemical composition appears almost the same as that of No. I., *very much larger* quantities were dissolved. I at once supposed that the fact noticed by some previous experimenters, viz., that mechanical treatment of lead alters its power of withstanding the action of solvents, must have materially influenced the results. That mechanical treatment does alter lead to an astonishing degree, so far as the action upon it of saline solution is concerned, will be made apparent from the experiments detailed in par. 12.

10. These experiments appear to show that it is not so much the chemical purity of the lead, as the mechanical treatment to which it has been subjected, which influences the solvent action of dilute saline solutions upon that lead. But the most remarkable feature in the numbers contained in Table VI. is the extraordinary falling off in the quantities of lead dissolved from No. 2 commercial sample when the experiments were carried out in beakers, as compared with the quantities dissolved in corked flasks. Taking, for instance, a solution of ammonium nitrate containing 0·20 grams of the salt per litre of water, it is found that 500 c.c. of this liquid, acting upon the surface of 25 sq. cm. of lead, dissolves 12·0 mgms. after 6 days' action, when the experiment is caried out in a corked flask nearly filled with liquid; but that the same quantity of the same solution acting on the same surface of the same lead is only able to bring a slight trace (*i.e.*, less than 0·20 mgm.) of lead into solution, after the expiry of the same time, when the experiment is conducted in

TABLE VI.

EXPERIMENTS IN CORKED FLASKS, NEARLY FILLED WITH LIQUID (500 C.C.).

Salt.	Grams per Litre.	Surface of Lead, sq. cm.	"Pure" Lead. Total Lead, in Mgms., dissolved after— 6 days.	"Pure" Lead. 14 days.	Commercial Lead, No. I. Total Lead, in Mgms., dissolved after— 6 days.	Commercial Lead, No. I. 14 days.	Commercial Lead, No. II. Total Lead, in Mgms., dissolved after— 6 days.
Distilled water..	—	25	—	1·2	trace	trace	12·0
Potassium nitrate	0·20	25	0·9	1·2	0·3	0·4	5·0
Ammonium ,, ...	0·20	25	1·3	1·8	1·5	1·0	12·0
Distilled water..	—	50	0·7	0·9	0·5	0·5	16·0
Potassium nitrate	0·20	50	1·1	1·2	1·7	0·5	12·0
Ammonium ,, ...	0·20	50	1·4	1·5	7·0	7·0	7·0
EXPERIMENTS IN BEAKERS, 500 C.C. LIQUID IN EACH.							
Distilled water..	—	25	0·4	0·5	0·3	0·3	0·5
Potassium nitrate	0·20	25	0·4	0·4	0·3	0·3	trace
Ammonium ,, ...	0·20	25	1·2	2·0	1·0	1·0	trace
Distilled water..	—	50	0·7	1·2	0·3	0·3	trace
Potassium nitrate	0·20	50	1·4	2·2	0·3	0·4	trace
Ammonium ,, ...	0·20	50	2·3	3·5	0·3	0·5	trace

beaker half filled with liquid and loosely covered with porous paper. The conclusion appears to be that the action of the air results in the formation of an insoluble lead salt. That this conclusion is the correct one appears from the following experiments. In the experiments with No. 2 sample of commercial lead very considerable precipitates formed on the lead itself and on the bottom of the vessels used. This was the case both in those experiments which were carried out in corked flasks and in those in beakers, but in the latter cases the precipitate generally appeared somewhat more bulky. On withdrawing a quantity of the clear liquid—holding lead in solution—from the flasks, and exposing it to the action of the air, a precipitate was in each case almost immediately formed. This precipitate increased in amount, until after a few hours a mere trace of lead could be detected in solution; the whole of the lead had been precipitated in an insoluble form. The corks were then withdrawn from the flasks, and the mouths loosely covered with porous paper; after 5 or 6 days the liquids contained only traces of lead in solution. From the liquids containing ammonium nitrate the lead was precipitated more slowly than from any of the others. The precipitate consisted of hydrated carbonate of lead $2PbCO_3,Pb(OH)_2$.

11. These results are apparently contradictory of those previously obtained, inasmuch as it has been already shown that in most cases more lead is dissolved when the air has free access to the surface of the liquid, and that the larger the surface of liquid exposed the greater is the amount of solvent action. I believe that the explanation of the results is to be sought for in the mechanical state of the samples of lead experimented upon.

12. With regard to the influence of hammering and rolling upon lead, so far as concerns the power of the lead to withstand the action of dilute saline solutions, I have meanwhile only a few experiments to bring before the Society. I propose, however, to investigate this subject in a more systematic manner, and hope, at a future date, to record the results.

TABLE VII.

EFFECT OF HAMMERING AND ROLLING ON LEAD.

EXPERIMENTS IN BEAKERS HALF FILLED WITH LIQUID (500 C.C. IN EACH) COVERED WITH UNSIZED PAPER.

Salt.	Grms. per litre.	Surface of Lead, sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 11 dys.	21 dys.
Potassium nitrate	0·20	50	Thin Lead foil "pure."	1·50	1·80
,, ,,	0·20	50	4 or 5 sheets of same lead rolled together into compact piece	trace	0·30
				26 dys	0·30

So far as these experiments go, rolling several sheets of "pure" lead foil into one compact sheet, very materially decreases the solvent action exercised upon that lead by a liquid containing nitrates.

TABLE VIII.

EFFECT OF ROLLING AND HAMMERING ON SAMPLES OF COMMERCIAL LEAD (BEAKERS).

Sample No. 1.

Salt.	Grms. per litre.	Surface of Lead. sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 6 dys.	14 dys.
Ammonium nitrate	0·20	25	As purchased	1·5	1·0
,, ,,	0·20	25	Several sheets rolled together then hammered	27·5	10·0
,, ,,	0·20	25	Several sheets hammered together, not rolled	trace	trace

Rolling several sheets of this lead together enormously increases the solvent action of ammonium nitrate upon the sample; hammering several sheets together has an opposite effect.

The following experiments illustrate the effect of rolling the original samples of commercial leads into thin sheets.

TABLE IX.

EXPERIMENTS CARRIED OUT IN CORKED FLASKS.

Sample No. 1.

Salt.	Grms. per litre.	Surface of Lead, sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 6 dys.	15 dys
Water..	—	25	As purchased	trace	trace
Potassium nitrate	0·20	25	,,	0·3	0·4
Ammonium ,,	0·20	25	,,	1·5	1·0
Water..	—	25	Rolled out till much thinner	none	none
Potassium nitrate	0·20	25	,,	none	none
Ammonium ,,	0·20	25	,,	trace	trace
Sample No. 2.					
Water..	—	25	As purchased	12·0	—
Potassium nitrate	0·20	25	,,	5·0	—
Ammonium ,,	0·20	25	,,	12·0	—
Water..	—	25	Rolled out till much thinner	trace	trace
Potassium nitrate	0·20	25	,,	trace	trace
Ammonium ,,	0·20	25	,,	—	10·0

Rolling these leads into thin sheets decreased the solvent action, except in one case, No. 2 sample with ammonium nitrate, when the action was not materially influenced.

TABLE X.

EXPERIMENTS CARRIED OUT IN BEAKERS (500 C.C. LIQUID IN EACH) LOOSELY COVERED WITH POROUS PAPER.

Sample No. 1.

Salt.	Grms. per litre.	Surface of Lead. sq.cm.	Nature of Lead.	Lead dissolved, in Mgms., after, 6 dys.	15 dys.
Water..	—	50	As purchased	0·3	0·3
Potassium nitrate	0·20	50	,,	0·3	0·4
Ammonium ,,	0·20	50	,,	0·3	0·4
Water..	—	50	Rolled out till much thinner	trace	trace
Potassium nitrate	0·20	50	,,	trace	trace
Ammonium ,,	0·20	50	,,	trace	trace
Sample No. 2.					
Water..	—	50	As purchased	trace	—
Potassium nitrate	0·20	50	,,	trace	—
Ammonium ,,	0·20	50	,,	trace	—
Water..	—	50	Rolled out till much thinner	trace	—
Potassium nitrate	0·20	50	,,	trace	—
Ammonium ,,	0·20	50	,,	trace	—

In these cases rolling also tended to decrease solvent action. I hope to continue these experiments, and to lay the results before the Society at another time.

13. As a general rule I observed that the greater the quantity of deposit upon the lead the smaller was the quantity of lead in solution. The deposit always consisted apparently of the same salt, and appeared as light shining crystals, sometimes arranged in beautiful feathery forms upon the surface of the slips of lead. Analysis showed that this salt was of the same composition as that noticed several years ago by Miller, viz.,

$$2PbCO_3,Pb(OH)_2.$$

14. I wish to make a correction with regard to the action of dilute solutions of calcium chloride upon lead. In Part I. of the present papers I stated that this salt retards the solvent action of water upon lead; this conclusion was deduced from the results of a single experiment. Since that time I have performed many experiments with solutions of the salt in question, and the general result is, that water containing small quantities of calcium chloride in solution dissolves decidedly greater greater quantities of lead than are dissolved by pure water under similar conditions.

RUSSIAN CHEMICAL SOCIETY.

W. SOROKIN, "*On Diallyl-methyl-carbinol.*" This non-saturated alcohol, $(C_3H_5)_2(CH_3)COH$, was obtained by the action of zinc on a mixture of 2 mols. allyl iodide and 1 mol. acetic ether, the yield being 16 per cent of the theoretical amount. The alcohol boils at 158·5°, possesses a characteristic odour, is insoluble in water, and has the specific gravity of 0·8638 at 0°. The acetic ether is obtained by treatment with acetic anhydride, and boils at 177°. By the action of bromine an unstable compound, $C_8H_{14}Br_4O$, is obtained, and a similar but still more easily decomposed body results from the action of bromine upon the acetic ether. Oxidation of the alcohol yields only carbonic and acetic acids.

A. SAYTZEFF, "*Notice on the Formation and Properties of the Alcohols belonging to the Series* $C_nH_{2n}O$." In the formation of these alcohols from the action of Zn and C_3H_5I upon oxygenated members of the fatty series, the author supposed that a derivative of the alcohol is first produced, in which the hydrogen of the group OH is replaced by the monovalent group ZnI,—

$$CH_3.CO.CH_3+C_3H_5.ZnI=(CH_3)_2C(C_3H_5)(OZnI),$$

and that this decomposed by water yields the alcohol—

$$(CH_3)_2C(C_3H_5)(OZnI)+H_2O=$$
$$=(CH_3)_2C(C_3H_5)OH+ZnIOH.$$

A comparison of the boiling-points shows that the acetic ethers boil 18·4° higher than their corresponding alcohols, and that the latter, when compared with trimethyl carbinol—as well as the respective acetic ethers—exhibit an elevation of from 34° to 41° in the boiling-point at each replacement of CH_3 by C_3H_5. Oxidation does not serve in the case of the non-saturated alcohols to give a clue to the structure, as when used to distinguish between the primary, secondary, and tertiary alcohols of the saturated series. Instead of attacking the carbon atom joined to the hydroxyl group, as in the case of the latter, oxidising agents act, in the author's opinion, upon the carbon atoms joined together by double bonds.

M. SAYTZEFF, "*On Diallyl-oxalic Acid.*" This acid, $COOH.C(C_3H_5)_2OH$, the first of the diatomic, monobasic, non-saturated acids belonging to the series—

$$C^nH_{2n-4}O_3,$$

which has been prepared synthetically, is obtained in the form of the ethylic ether, by the action of zinc and allyl iodide upon oxalic ether. This ether is a colourless liquid, boiling at 213·6°, and by treatment with baric hydrate yields the acid in the form of an oil, which gradually becomes crystalline. A number of the salts are described. Oxidation yields no recognisable products. An ethereal solution of the acid forms, upon addition of bromine, tetra-bromo-diallyl-oxalic acid, $C_8H_{12}Br_4O_3$.

J. KANONNIKOFF and N. SAYTZEFF, "*On the Preparation of Allyl Iodide and Acetic Anhydride.*" The ordinary preparation of allyl iodide is altered by allowing the reaction and subsequent distillation to proceed in an atmosphere of CO_2. By this means 1000 grms. of iodine, 3000 grms. of glycerin, and 300 grms. of phosphorus yield 1100 to 1150 grms. of C_3H_5I. Acetic anhydride can be prepared according to Linneman's method for obtaining butyric anhydride, by the action of acetyl chloride upon glacial acetic acid. The process gives 50 per cent of the theoretical amount.

A. SEBANIJEFF, "*Action of Zinc upon Organic Compounds containing Halogens.*" The action was studied upon the alcoholic solutions. Ethylen bromide and iodide, and propylen bromide are violently decomposed, forming C_2H_4, $ZnBr_2$, &c. Ethylen chloride is decomposed with difficulty, and trimethylen bromide is not attacked. Chloroform is acted upon very slowly by granulated zinc, but quite rapidly by zinc-dust, CH_4 being evolved. The presence of water favours the reaction, and would point to this decomposition:—

$$2CHCl_3+3H_2O+3Zn_2=CH_4+3ZnO+3ZnCl_2.$$

M. LEWITZKY, "*Upon the Existence of a Resistant Medium in Space.*"

ACADEMY OF SCIENCES, ST. PETERSBURG.

N. ZININ, "*On Isolepidene.*" The author finds that by the dry distillation of oxylepidene, oxylepidic acid, $C_{28}H_{22}O_3$, and isolepidene, $C_{28}H_{20}O$, are both formed, the latter amounting to one-half of the weight of the oxylepidene used. By treatment with zinc and acetic acid, isolepidene is changed into dihydrisolepidene, $C_{28}H_{22}O$, —a body melting at 182°, not easily attacked by chromic acid or oxidising agents, and resisting the action of chlorine and phosphorus pentachloride much more strongly than isolepidene. By reduction with sodium amalgam both isolepidene and dihydrisolepidine are changed into tetra-hydrisolepidine, $C_{28}H_{24}O$, melting at 132°, easily oxidisable to the dihydro compound. By the action of

oxidising agents, such as chromic acid, isolepidene is changed either into monoxy-isolepidene, $C_{28}H_{20}O_2$, or benzophenon, $(C_6H_5)_2CO$, according to the violence of the reaction, in both cases benzoic acid being formed. Monoxy-isolepidene melts at 161°, and is dimorph, the crystals being changed from one form to another by boiling with a small amount of alcohol. Reduction changes it into dihydrisolepidene.

H. WILD, "*On a Normal Barometer.*" In a lengthy paper the author maintains that the normal barometer of the Physical Central Observatory in St. Petersburg is the only one in existence giving the pressure directly, without further correction. The degree of possible error is limited to 1-100th m.m. The normal barometers of other countries are considered in detail; and he regards the instruments at Kew, Greenwich, London (Royal Society), Paris, and Vienna as entirely unreliable for absolute measurements. A list of the conditions necessary for the attainment of an accuracy of 0·025 m.m. is added.

CORRESPONDENCE.

THE ACTION OF ORGANIC ACIDS ON MINERALS.

To the Editor of the Chemical News.

SIR,—Permit me, through the medium of your widely-read Journal, to make a brief preliminary announcement of some results obtained in the course of an investigation now in progress. I refer to the behaviour of minerals with certain organic acids, with a special view to the application of the latter in determinative mineralogy.

Contrary to preconceived ideas, based on general notions of the weakness of organic acids, I find that many minerals in fine powder are decomposed by boiling with solutions of citric, tartaric, oxalic, and other organic acids. Not only do all the carbonates examined (fourteen in number) dissolve with effervescence in solutions of the above-named acids, but many sulphides, silicates, and other classes of minerals are more or less completely decomposed. In some cases the accompanying phenomena —such as evolution of gases, formation of crystalline, precipitates, &c.—are characteristic of certain minerals; for example, all the specimens of bornite examined yield sulphuretted hydrogen with tartaric acid (also citric and oxalic), while chalcopyrite does not; again, pyrrhotite yields sulphuretted hydrogen under similar circumstances, and pyrite gives no such reaction. Moreover, since citric and tartaric acids decompose potassium nitrate, setting nitric acid free, we have a powerful means of attacking sulphides and arsenides which resist the organic acids alone. All the sulphides examined (seventeen in number), with two exceptions, molybdenite and cinnabar, are quickly decomposed by heating with citric or tartaric acid to which a small quantity of potassium nitrate has been added. Even metallic copper, lead, tin, and silver dissolve in the above mixture of reagents. Potassium chlorate answers very well in place of the nitrate, but the action is slower. Oxalic acid fails to decompose the nitrate or the chlorate of potassium. The action of these acids on the silicates now engages my attention; several of them (natrolite, datolite, wollastonite, calamine, &c.) yield readily to the action of citric acid in solution, gelatinising as with mineral acids.

Aside from the interest which it seems to me attends those reactions, there is a manifest advantage in being able to add tartaric (or citric) acid to pocket travelling blowpipe-cases; the dry acids are readily transported, and can be dissolved when needed for use. It was during a mineralogical tour last summer that the thought suggested itself of trying the behaviour of minerals with tartaric acid, as a substitute for the mineral acids whose carriage is impracticable.

For microscopic work, also, the use of these non-volatile acids may be recommended, thus avoiding possible injury to the metallic mountings.

Besides the three organic acids named, I have examined the action, on carbonates at least, of malic, formic, and acetic acids, for sake of comparison; acetic acid gives the least satisfactory results.

So far as I can ascertain, this field has not hitherto been explored. I have ransacked chemical literature for similar studies in vain, and Prof. Edward J. Chapman, of Toronto, who is high authority in determinative mineralogy, writes me that while organic acids have long been used in chemical analysis, their direct application to the examination of minerals is, to the best of his knowledge, entirely novel.—I am, &c.,

H. CARRINGTON BOLTON.

School of Mines, Columbia College, New York,
February 7, 1877.

ESTIMATION OF UREA.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxv., p. 81) Dr. Dupré is reported to have read a paper before the Chemical Society "On the Estimation of Urea by Hypobromite." From your abstract of the above paper I gather that Dr. Dupré's apparatus is almost identical with that described by me in the CHEMICAL NEWS, vol. xxxi., p. 36. I, however, feel gratified by the fact that my apparatus has been found efficient by Dr. Dupré, and I take this opportunity of thanking him for explaining its merits to the Fellows of the Chemical Society.—I am, &c.,

RICHARD APJOHN.

Gonville and Caius College, Cambridge,
March 5, 1877.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—Mr. Pattison Muir's letter, relating to the 200 analyses by our ammonia process, carried out by his brother in Australia, affords another testimony to the wide-spread usefulness of the ammonia process, and as such was read by me with great pleasure. I am, however, bound to call attention to the fact that the alterability of polluted water when it is kept was well known to the discoverers of the process even so far back as the year 1867, and is alluded to in the various editions of the "Water Book." The direction on page 8, "The sample of water should be kept in a cool and dark place until it is examined; and the examination should, if possible, take place within forty-eight hours after the collection of the sample" was given because of our knowledge of the changes in water. On page 130 is a still more explicit statement.—I am, &c,

J. ALFRED WANKLYN.

OXIDISING ACTION OF ANIMAL CHARCOAL UPON ORGANIC MATTERS.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxxv., p. 101, there is a paper by Mr. Thomson of great interest from many points of view. Would Mr. Thomson gratify your readers, if in a position to do so, by furnishing them with the analysis of the mixture of "prussiate char" and night-soil at the beginning of the experiment, and more especially with its present composition. What has happened to the total nitrogen he had to start with? How much is now present in the heap and in what form? How much gone to the atmosphere? I may mention that at a slaughter house near this city an experiment was lately made by taking 15 tons of waste flesh and animal offal, chiefly intestines, which were mixed with 2 tons seaweed char-

coal and 2 tons animal charcoal. The ingredients were as carefully mixed as possible and made into a heap, which stood for three months before being touched. I had never seen the heap till the end of that time, when it was noticed that clouds of steam were rising from the mass, and the temperature in the centre was as much as 130°. The smell of ammonia all round was very intense and on turning over any portion with a shovel was unbearable. This odour was, however, purely ammoniacal and had no cadaverous characteristic. The animal matter used contained 2·83 per cent nitrogen and 51 per cent water; the charcoal 0·4 per cent. The heap at the end of four months was found to yield 1·4 per cent nitrogen with 45·5 per cent water. The loss of nitrogen, chiefly to the atmosphere, amounted to 50 per cent of the total amount originally present. This was not encouraging to my friend who made the experiment, but I purpose to have another trial, using precautions to keep down the temperature if possible, and using acidified charcoal. If Mr. Thomson can supply any more particulars of his heap it would be very instructive.—I am, &c.,

ROBT. F. SMITH.

Glasgow, March 10, 1877.

P.S.—I omitted to state that no nitrates were found in the resulting compost.—R. F. S.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
No. 1, January 5, 1877.

Easy Method of Obtaining Glycolic Acid.—C. Z. Crommydis.—The author has obtained large quantities of glycolic acid, containing scarcely a trace of glyoxalic acid, by acting upon oxalic acid with zinc in the water-bath.

Watering of Wines and its Indications: Influence of Plastering, Glueing, &c., upon the Weight of the Dry Extract.—A. Gautier.—Not capable of useful abstraction.

Determination of Phosphorus and Arsenic by the Molybdate of Ammonia.—MM. Champion and H. Pellet.—M. Boussingault has shown that the approximation furnished by directly weighing the phospho-molybdate is superior to that obtained by re-dissolving the precipitate and determining the phosphorus as ammoniaco-magnesian phosphate. The error committed is the more appreciable the less phosphorus is present in the matter under analysis. According to M. Boussingault the phospho-molybdate contains 3·73 per cent of phosphoric acid. The operation may be performed very rapidly by observing the following precautions:—Dissolve 100 grms. molybdic acid in ammonia (about 150 c.c. of ordinary ammonia) and 80 of water. Pour it drop by drop into 500 c.c. of pure nitric acid and 300 c.c. of water. Stir, let settle, and filter if needful. Introduce into a capsule such a measure of the molybdic solution that the weight of the molybdic acid may be about fifty times the supposed weight of the phosphoric acid. Add ammonia to render the liquid alkaline; concentrate as far as possible the liquid containing the phosphoric acid, and mix the two solutions; raise the temperature to 70° to 80°, and pour in rapidly an excess of nitric acid until the yellow colouration appears, stirring briskly to aid the formation of the precipitate. Filter through a double tared filter, wash, and dry at 100° to 110°. The filtrate should be colourless. If it is yellow the precipitation is incomplete; in this case ammonia is poured upon the filter to re-dissolve the precipitate, the solution is evaporated, and re-acidified with nitric acid. The same process may be successfully applied to the determination of arsenic, 100 grms. of the precipitate of arsenio-molybdate of ammonia containing 5·1 of arsenic acid.

Catechu de Laval, a New Colouring Matter for Linen and Cotton.—This name has been given by MM. Croissant and Bretonnière to the sulphuretted organic colouring matters which they discovered some years ago. Though these products have no analogy with catechu they give certain catechu shades. The colour produced upon cotton is modified according to the method of fixation employed. The fixation is effected either with an acid (sulphuric or muriatic), with sulphate of copper, or iron, and especially with bichromate of potash. Catechu de Laval is characterised by its affinity for vegetable fibres, and by its power of serving as a mordant for a number of colours which are not capable of dyeing cotton directly, such as the aniline colours, the extracts of the woods, &c. To dye cotton, from ½ to 2 kilos. of the colour are dissolved in ten times its weight of boiling water, as pure as possible (especially free from lime) to 10 kilos. of cotton. As the solutions are unstable they must only be prepared as wanted. This solution is gradually strained into 100 litres of water at 60°. At the end of the dyeing bisulphite of soda is added to the bath in the proportion of 75 to 100 grms. per every 100 grms. of colour. The dyeing lasts from twenty to twenty-five minutes. The cotton is then washed, and passed into a hot beck of 300 grms. bichromate or of another fixing agent (sulphate of copper or iron) 200 grms. sulphuric acid, or 500 grms. muriatic acid. After a few minutes the cotton is taken out and dried. To obtain compound colours the cotton dyed as above, and well washed, is passed into baths of magenta, extracts of the woods, &c. Catechu de Laval may be used for dyeing jute, linen, &c. It must be preserved from damp.

Action of Alkaline Ferridcyanide of Potassium upon Colours obtained from Madder and its Derivatives, as well as upon its Artificial Substitutes.—M. Wagner.—On printing upon mordanted goods dyed in madder, garancin, or artificial alizarin, a thickened solution of ferridcyanide of potassium, and passing into a bath of caustic soda, the author finds that shades consisting entirely of alizarin resisted perfectly. Those containing purpurin were more or less impoverished, according to the proportion of purpurin present, whilst colours composed of purpurin alone were entirely discharged.—*Moniteur de la Teinture.*

A Steam Indigo Blue.—M. C. Zürcher.—A colour to answer all the conditions of such a blue ought to contain, besides the thickening, a reducing agent and a body neutral in the cold, and becoming alkaline at the temperature of the steaming process. Schlumberger proposed the cyanide of potassium, but this substance, in addition to its high price, is a dangerous poison. The author finds that the alkaline bicarbonates whose alkalinity is much heightened at 70° to 80° are then capable of dissolving white indigo. A colour formed of 1 litre of neutral gum-water, 250 grms. protoxide of tin in a paste, 100 grms. bicarbonate of soda, and 300 grms. of ground indigo at 20 per cent, is not reduced in the cold, but when heated reduction ensues, and the white indigo is dissolved. When printed upon the cloth the colour is only reduced by very moist steaming.—*Moniteur de la Teinture.*

No. 2, January 20, 1877.

At the meeting of the Society December 15, 1876, M. Lecoq de Boisbaudran stated that on roasting blende gallium and indium remain, which may be extracted by treatment with an insufficient quantity of sulphuric acid; sulphate of zinc is formed, whilst gallium and indium remain in the undissolved portion.

In the current issue of the *Bulletin* there are no original papers. The following memoirs are taken from other sources.

Preparation and Properties of the Chlorides, Bromides, and Oxide of Gold.—M. J. Thomsen.—This

paper (taken from the *Journal für Praktische Chemie*, New Series, xiii., 337) describes the intermediate chloride, Au_2Cl_4, formed by the action of chlorine upon pulverulent gold, the anhydrous chloride $AuCl_3$, obtained by treating the foregoing compound with water; the hydrated chloride, $AuCl_3+2H_2O$; aurous chloride, AuCl, formed by the action of a temperature of 185° upon the anhydrous trichloride; the intermediate bromide and the anhydrous tribromide, analogous to the corresponding chlorides; the hydrobromate of tribromide, $AuBr_4H,5H_2O$; the aurous bromide, and the hydrated oxide.

Actions of Affinity Manifested in the Slow Oxidation of Hydrogen and of Carbonic Oxide under the Influence of Platinum-Black.—M. E. von Meyer.—The presence of carbonic oxide in mixtures of hydrogen and oxygen does not destroy but lessens the action of the platinum, the carbonic acid being oxidised in preference. —*Journ. f. Prak. Chemie.*

Thermic Researches on Gold and its Compounds.—M. J. Thomsen.—Not suitable for abstraction.—*Journ. f. Prak. Chemie.*

Action of Alcoholic Ammonia upon Oxalate of Methyl.—M. A. Weddige (*Journ. f. Prak. Chemie*).—The author on treating methylic oxalate with ammonia dissolved in ethylic alcohol obtains oxamate of ethyl.

Ethers of Sulphuric Acid.—M. Mazurowska (*Journ. f. Prak. Chemie*).—Not suited for abstraction.

Transformation of Para-oxy-benzoic Acid into Salicylic Acid.—M. Kupferberg (*Journ. f. Prak. Chemie*).—This transformation, suggested by Ost, is only possible in part.

Utilisation of the Sulphur of Gypsum and of the Sulphate of Soda employed in the Glass Manufacture.—M. O. Schott (*Dingler*, ccxxi., 142).—The author forms a double silicate of lime and soda by heating together silica, sulphate of soda, and gypsum with the quantity of carbon necessary to reduce these salts. Complete fusion of the mixture is not needed. The sulphurous acid evolved may be passed at once into the lead chambers. The double silicate produced—which the author calls *crude glass*—serves for the manufacture of glass by fusion along with silica, soda, or lime, according to the nature of the glass to be produced. The proportions for the crude glass itself may be modified as deemed requisite. One of the objections made by glass manufacturers is that the escape of gas during vitrification is necessary to render the mass homogeneous. But as each kilo. of the mass to be vitrified gives off 1 litre of gas, this quantity is much more than sufficient. A certain quantity of unreduced mixture may be added to complete the vitrification of the "crude glass." In the reduction of the sulphates we may substitute for carbon a sulphide, such as soda-waste; the sulphurous acid escaping is then free from carbonic oxide, and its transformation into sulphuric acid in the chambers is effected with more regularity.

Action of Various Saline Solutions upon Metals.—M. A. Wagner (*Dingler*, ccxxi., 259).—Copper is attacked by all the salts experimented with in presence of carbonic acid, especially by sal-ammoniac. Zinc is also attacked by all, most strongly by chloride of magnesium. Lead is attacked neither by potassic sulphate nor sodic carbonate. Tin is scarcely attacked by the alkaline chlorides, somewhat more by carbonates, and very strongly by caustic soda.

NOTES AND QUERIES.

Lubricating Mineral Oil.—Is it possible to bleach or discolour lubricating mineral oil?—E. R.

Elastic Cement for Iron.—Could any of your readers inform me of a cement that does not readily dry up and crack when exposed to the weather, and is sufficiently adhesive to stick to galvanised iron when placed in joints of sheets? I have tried white and red lead but they always dry rapidly and fall out of the joints.—C. P.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—London Institution, 5.
—— Medical, 8.
—— Society of Arts, 8. (Cantor Lectures). "Chemistry of Gas Manufacture," A. Vernon Harcourt, F.R.S.
TUESDAY, 20th.—Royal Institution, 3. Prof. Garrod, "On the Human Form: its Structure in Relation to its Contour."
—— Civil Engineers, 8. Discussion on "The Transmission of Motive Power to Distant Points." "The River Thames." by J. B. Redman, M. Inst. C.E.
—— Zoological, 8.30.
WEDNESDAY, 21st.—Society of Arts, 8. "Vital Air," by Dr. W. B. Richardson, F.R.S.
—— Meteorological, 7. "Results of Meteorological Observations made at Patras, Greece, during 1874 and 1875," by the Rev. Herbert A. Boys. "Contributions to the Meteorology of the Pacific—Fiji," by R. H. Scott, F.R.S. "Local Diurnal Range," by S. H. Miller, F.R.A.S. Several new Instrumeuts will be exhibited by Messrs. Negretti and Zambra.
—— Geological, 8.
THURSDAY, 22nd.—Royal, 8.30.
—— Royal Institution, 3. Dr. W. Pole, "Theory of Music."
—— Philosophical Club, 6.30.
—— London Institution, 7.
—— Zoological, 4.
FRIDAY, 23rd.—Royal Institution, 9. "Influence of Chemical Constitution upon Refraction of Light," Professor Gladstone, F.R.S.
—— Quekett Club, 8.
SATURDAY, 24th.—Royal Institution, 3. Prof. H. Morley on "French Revolution and English Literature."

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THE CHEMICAL NEWS.

VOL. XXXV. No. 904.

ON SOME PRELIMINARY RESEARCHES ON THE ACTION OF MAGNESIUM ON SOME ORGANIC COMPOUNDS.

By SERGIUS KERN, St. Petersburg.

MAGNESIUM acts on many organic compounds nearly in the same way as the copper-zinc couple in the experiments of Gladstone and Tribe. Ethylen iodide ($C_2H_4I_2$) and ethylen bromide ($C_2H_4Br_2$) with a small quantity of ethyl-alcohol and some pieces of magnesium, being gently heated, evolve readily pure ethylene (C_2H_4). Instead of ethyl-alcohol water may be used with the same results.

This reaction may be used with success in preparing pure ethylene for chemical researches.

Magnesium in powder acts very strongly on most of the organic compounds. It is better to use it always in a state of fine powder, obtained by the action of sodium on magnesium chloride.

With chloroform, and a small quantity of water, magnesium gives a very energetic reaction, with the evolution of methyl hydride—

$$2CHCl_3+3H_2O+6Mg=2CH_4+3MgO+3MgCl_2.$$

In the same way magnesium-powder acts on iodoform and bromoform.

If we act on an alcoholic solution of $C_2H_2Br_4$ by magnesium we obtain acetylene dibromide by the reaction—

$$C_2H_2Br_4+Mg=C_2H_2Br_2+MgBr_2.$$

Care must be taken not to apply heat, because, on heating, instead of acetylene dibromide acetylene is obtained :—

$$C_2H_2Br_4+2Mg=C_2H_2+2MgBr_2.$$

Propylene bromide ($C_3H_6Br_2$) with the addition of water and magnesium evolves pure propylene—

$$C_3H_6Br_2+Mg=C_3H_6+MgBr_2.$$

On ethyl bromide (C_2H_5Br) magnesium acts with the addition of H_2O and C_2H_6O very readily, with the formation of a compound C_2H_5MgBr, which yields $MgBr_2$ and $(C_2H_5)_2Mg$. In presence of water only, the brommagnium ethyl (C_2H_5MgBr) gives the hydrated bromoxide of magnesium and ethyl hydride—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\};$$

With ethyl alcohol, if water is not present, the obtained C_2H_5MgBr yields C_2H_5OMgBr, and also the same gaseous product—ethyl hydride.

On ethyl iodide (C_2H_5I) magnesium acts in a corresponding manner.

All the above-mentioned reactions require a low temperature not more than 30° to 40°, and in some cases even less. The magnesium, in powder, may be used with far more success than any other reagents, in order to obtain various hydrocarbons from their numerous compounds.

These experiments are the continuation of some of my researches on the action of magnesium on certain metallic salts, which shewed many interesting reactions of this metal (CHEM. NEWS, vol. xxxii., No. 840; vol. xxxiii., Nos. 851, 863).

Magnesium ethyl—

$$\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}Mg$$

is easily obtained by the action of magnesium powder upon ethyl iodide; if slowly oxidised this compound is transformed into magnesium ethylate—

$$\left.\begin{matrix}2(C_2H_5)\\Mg\end{matrix}\right\}O.$$

Magnesium ethyl is a valuable reagent, by means of which many other organic compounds may be obtained far more easily than by the action of zinc ethyl.

Using instead of zinc ethyl magnesium ethyl, many compounds of the alcohol radicals with metals were prepared in a very pure state. By this way ethyl compounds of mercury, silicon, tin, boron, lead, and other metals were made.

Obouchoff Steel Works.

ON THE FORMATION OF "MOSS COPPER."

By W. M. HUTCHINGS.

DOUBTLESS many readers of the CHEMICAL NEWS have, like myself, taken great interest in Professor Liversidge's experiments and observations on the formation of moss gold and silver (CHEM. NEWS, vol. xxxvi., p. 68), and would welcome any further investigations and explanations bearing upon this very interesting and little-understood subject. What is, perhaps, the most interesting and curious fact recorded by Professor Liversidge, is the very low temperature at which the "moss" is formed. In the case of moss copper, I was greatly struck by some observations which I made during some experiments a couple of years since, and which I have repeated several times since reading the paper by Professor Liversidge. I took about ¼ lb. of regulus (containing 65·9 per cent. copper) and fused it under borax in a clay crucible, pouring the molten mass into an iron mould. After cooling slowly (by using a thin mould and standing on a hot plate) the regulus was found to contain a large amount of disseminated copper, the fractured surface showing numerous veins, and little nests of needles and jagged points, in small cavities in the regulus, even to the naked eye, while a lens or microscope showed the entire surface dotted with particles of copper. When a small portion of the regulus was fused as above and cooled very rapidly, very little copper was visible under the microscope.

When a large button of regulus (¼ lb. as above) had cooled in the mould for some time, so that it had been quite solidified for some minutes, it was laid on an anvil and broken in two by a blow with a hammer. It was still much too hot to hold in the hand, but had cooled far below redness, even in the centre. At the moment of fracture the surfaces exposed were perfectly clean and lustrous; looked at quickly with a lens, they showed only the little veins and nests and imbedded particles of the disseminated copper; but in the course of a minute or two they were seen to become slowly covered with a growth of minute copper filaments, which increased, till in some places it resembled a coarse velvet. After three or four minutes one of the halves was again broken in two, and again the fresh and lustrous surface of regulus exposed, which contrasted strongly with the surface already covered with "moss." The piece was now just cool enough to be held in the hand. In the course of a few minutes this also showed moss copper on the surface, though not nearly so much as the first fracture, and only in patches, which formed very slowly. In all cases the growth is most extensive on the hotter parts of the surface—those nearest the centre—and if large buttons of regulus are broken while still much hotter than above mentioned, a far thicker covering is rapidly obtained.

Of course there is no question here of this "moss copper," being formed at a temperature sufficient to soften copper. Even at the time of the first fracture, the centre of the button was not nearly at the temperature of melting lead, and when fractured the second time the pieces were certainly not ever 100° C. Nor is there any uni-

dation of the surface of the regulus, for where this is seen in amongst the copper filaments, it retains its lustre as when freshly broken.

Seen under the microscope these filaments (which in these small experiments are exceedingly minute), exactly resemble the larger ones described by Dr. Percy, being deeply grooved and striated. Many of them are broad and flat, like blades of grass, as described by Professor Liversidge in the case of moss silver, and many seem to show plainly that they were formed by the union of several finer threads, as they look, when magnified, exactly like coiled wire rope.

Laboratory, Wallasey Ore Works, Birkenhead.

THE ACTION OF MANGANESE DIOXIDE ON AMMONIUM NITRATE.

A NEW METHOD OF PRODUCING NITROGEN.

By J. W. GATEHOUSE.

When binoxide of manganese is heated with ammonium nitrate, a violent action occurs, and if the external temperature is maintained the action may become so intense as to raise the contents of the vessel to dull redness, when abundance of the red vapours of nitrogen tetroxide are evolved.

The action begins at a temperature of 360° F., which is the point at which nitrate of ammonia itself decomposes, and if temperature is maintained between 360° and 390° F. great frothing occurs, and a constant stream of an invisible gas, which neither supports combustion nor is absorbed either by water or by solution of pyrogallic acid and potash, is evolved.

This gas is pure nitrogen, and is disengaged according to the following equation:—

$$MnO_2+4NH_4NO_3=Mn2NO_3+8H_2O+6N.$$

320 grammes of ammonium nitrate should thus evolve 67,140 cubic centimetres of nitrogen at normal temperature and pressure.

An experiment, in which 3 grammes of ammonium nitrate were heated with an equal weight of manganese dioxide in a mercury bath to a temperature not above 400° F. yielded 606 cubic centimetres of nitrogen, a number sufficiently near to the theoretical amount 630 c.c. to show the above equation to be practically correct.

When the temperature is allowed to rise above 420° F. a more complex action ensues, the nitrate of manganese, being apparently decomposed into manganese dioxide, nitrogen tetroxide, and oxygen.

An analysis of the gas evolved at 430° F., after passing it through water, gave the following results:—

Gas taken, 12 c.c.; absorbed by water, nothing appreciable; after absorption by solution of pyrogallic acid and potash, 10·98 c.c. Amount of oxygen in 12 c.c. of gas = 1·02 per centage of oxygen, 8·5. As by the equation $MnO_2+2NH_4NO_3=Mn2NO_3+N_2+2H_2O+H_4$ it was possible that hydrogen might be evolved, a special experiment was made with electrolytic gas and excess of oxygen by combustion in an eudiometer, but with negative results, no hydrogen being discoverable.

We are thus warranted in coming to the conclusion that at temperatures between 360° and 400° F. a mixture of equal weights of manganese dioxide and ammonium nitrate yield pure nitrogen, but that at temperatures above 420° tetroxide of nitrogen and oxygen are also evolved from the decomposition of the nitrate of manganese first formed.

The Laboratory, 36, Broad Street, Bath.

Substitution of Borate of Lime for Lime in Refining Sugars.—The use of the monoborate of lime in sugar refining prevents the formation of glucose, and diminishes the proportion of crystalline sugar going off in the form of treacle.—*Les Mondes.*

REPORT
ON THE
DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 89.)

Manufacture of Sulphuric Acid. By Robert Hasenclever, Manager of the Stolberg Works.

Roasting of Various Metallic Sulphides.—At Freiberg and in the Harz galena is used for the manufacture of sulphuric acid, and is roasted for this purpose in large wide shaft-furnaces containing 250 cwts. The ore gives off the half of its sulphur and yields a gaseous mixture containing 4 to 6 per cent of sulphurous acid.

Copper pyrites are used for making sulphuric acid both at Chessy and at Oker in the Harz, and are roasted for this purpose in small tubes. At Mansfield also copper ores are desulphurised in kilns, the Gerstenhöfer furnaces introduced for this purpose having been abandoned. In Swansea, on the other hand, the ground ore is roasted in Gerstenhöfer furnaces, which are there found to work satisfactorily. The lead chambers at Swansea are at the distance of about 20 metres from the furnaces, so that the greater part of the flue dust is deposited before reaching the chambers.

In the "Report on the London Exhibition of 1862," Dr. A. W. Hofmann† mentions that Lawes, of Barking Creek, on the Thames, employs in the manufacture of sulphuric acid the oxide of iron which has served for the purification of coal-gas, and which has become rich in sulphur. This so-called "Laming's mass" is now also used by the St. Gobain Company, of Aubervilliers, near Paris; by Seybel, of Liesing, near Vienna; by Kunheim and Co., of Berlin, and probably also elsewhere. The roasting is conducted partly upon earthen plates, partly in furnaces with narrow grates, the gases obtained being well suited for the manufacture of sulphuric acid.

Zinc blende has found of late years a more extended employment in the manufacture of sulphuric acid, and its use will probably be further extended. The chemical works "Rhenania," at Stolberg, near Aachen, may claim the merit of having thoroughly studied the utilisation of the gases escaping on roasting zinc blende and of having carried the process out in the most complete manner. Twenty years ago blende was roasted at Stolberg in a reverberatory furnace of two stages, according to F. W. Hasenclever's patent. The upper hearth formed a muffle constructed of vaults, in which the blende underwent a preliminary roasting, the sulphurous acid evolved being passed into the chambers. The roasting of the ore was then completed on the lower hearth. When pyrites were cheap it was not remunerative to use blende, as the desulphurisation remained imperfect and gases too poor in sulphurous acid entered the chambers. The simple muffle-furnace was improved by Eugene Godin, whose plan did not come into operation at Stolberg until 1865, after his death. The ores, before arriving upon the hearth of the reverberatory heated by the products of combustion pass over seven plates of fire-clay, arranged one above another. The spent ores are withdrawn below, the charge of the second is removed to the first, that of the third to the second, &c., and green ore is thrown upon the seventh. In this furnace the roasting took place in a satisfactory manner, and the gases were rich in sulphurous acid. Labour, however, was high, and the loss of gas whilst charging was considerable. If the draft was increased the gases were too much diluted by the entrance of air at the doors.

In 1866 the Gerstenhöfer furnace was introduced at Stolberg for roasting zinc blende and used for some time.

* "Berichte über die Entwickelung der Chemischen Industrie Während des Letzten Jahrzehends."

† A. W. Hofmann, "Reports by the Juries," 1862, 15.

At the best it only succeeded in utilising half the sulphur of the blende. On the other hand, the amount of flue dust (the blende there in use being very finely granular) was excessive, so that this furnace has proved as little adapted for roasting blende at Stolberg as at Borbeck and Swansea.

Since 1870 the muffle-furnaces formerly employed at Stolberg have been combined with a system of plates according to the design of Hasenclever and Helbig. The system has subsequently experienced important modifications, retaining the principle for inclined plates, until a kiln for blende has been developed which has now for some years been found suitable to be retained in an unmodified form.* The products of combustion, which play round the muffle, heat from below an inclined plane formed of plates and about 8 metres in length. On this inclined plane the ore slides down to a roller fixed at the lower end, and as this revolves is delivered first into the muffle, whence it is drawn down by manual labour into the lower hearth, where it is roasted until fit to be smelted for zinc. The gases escaping from the muffle, still poor in sulphurous acid, sweep over the inclined plane, become richer, and effect a preliminary roasting of the blende. Since finely granular bodies if thrown on a heap form a surface with an approximately constant angle of 33°, as the ore slides down the plane which has an inclination of 43° there would be formed at the bottom a heap of more than 1·5 metre in depth, a perfect roasting of the interior of which would be impracticable. To prevent the stratum of ore from becoming too thick partitions are arranged, which descend to the distance of a few centimetres from the slope. In this manner a thin stratum of ore is maintained over the whole surface. Furnaces of this construction are at work at Oberhausen and Stolberg, and are in course of construction at Lethmathe, near Iserlohn, and Rosdzin, in Silesia. The consumption of fuel is the same as in the roasting kilns common at zinc works, 28 per cent of coal to 100 raw blende; the cost of labour is 1·6 of a shilling per 100 kilos. blende.

In Freiberg a black blende, containing iron pyrites in considerable amount, is used for the manufacture of sulphuric acid, the broken ore being submitted to a preparatory roasting in large kilns. The burnt residue is then ground and receives its final roasting in a reverberatory.

Formation of Sulphuric Acid in the Lead Chambers.—Recently, as well as in earlier years, proposals have been made to substitute some other apparatus for the chambers. Verstraet† employs for this purpose columns formed of earthen vessels. But his method, like earlier suggestions for preparing sulphuric acid on any other than the traditional principle, has not become of practical importance.

The chemical process during the formation of sulphuric acid in the chambers, and the reactions involved, have been latterly further explained.

Reich‡ introduced a method of determining the sulphurous acid in the gases from the kilns and furnaces, which has met with an extensive application. He uses a solution of iodine in potassic iodide of known strength, to which a little starch has been added. By aspiration the gas is drawn through the blue liquid till decolouration is effected. If the volume of the aspired gases has been measured the percentage of sulphurous acid is known. This method of examination has the great advantage that it can be accurately executed by a common labourer (?), the solution of iodine merely being prepared in the laboratory.

The composition of kiln gases theoretically the most advantageous was first calculated by Gerstenhöfer, and was communicated to several chemical works as early as 1866. The same calculation, with a slight difference, was subsequently produced by Schwarzenberg.‖ According to his assumption, when the chambers are working well the gaseous mixture leaving them should still contain 5 per cent (by volume) of oxygen. Hence the normal composition of the gases entering, when sulphur is employed, must be:—

Sulphurous acid (by volume) ..	11·23
Oxygen	9·77
Nitrogen	79·00

and when pyrites are in use, and the gases at their exit contain 6·4 per cent of oxygen—

Sulphurous acid	8·59
Oxygen	9·87
Nitrogen	81·54

Since, for every 1000 grms. of sulphur used in the form of bisulphide of iron 8144·9 litres of gas (calculated at 0° temperature and at a pressure of 760 m.m. of mercury) enter the chambers, and for the same weight burnt in the free condition only 6199 litres, a given quantity of sulphur burnt as bisulphide of iron, yields—

$$\frac{8144{\cdot}9}{6199} = 1{\cdot}314$$

times as much gas as if it had been burnt in the free condition.

(To be continued.)

Hasenclever and Helbig, *Zeitschr. des Vereins Deutscher Ingenieure*, 1872, 705.

† Verstraet, *Dingl. Pol. Journ.*, clxxix., 63. *Wagner Jahresber.*, 1865, 226.

‡ Reich, *Berg und Huttenm. Zeitung*, 1858.

‖ Schwarzenberg, "Bolley's Handbook der Technologie," ii., 355.

SHORT REPORTS FROM THE CHEMICAL LABORATORY OF TRINITY COLLEGE, DUBLIN.

By J. EMERSON REYNOLDS, M.D., M.R.I.A., Professor of Chemistry, University of Dublin.

No. I.—*On Glucinum: its Atomic Weight and Specific Heat.**

Amongst the few rare elements found in Ireland is the metal glucinum or beryllium, which occurs in the well-known alumino-glucinic silicate, beryl or "emerald." This mineral is found in comparative abundance, though in a rough state, in the granites of Donegal, and is somewhat less freely distributed through the granites of the Mourne Mountains, in the county of Down. As the "atomic weight" of glucinum has not yet been definitely fixed by the determination of the specific heat of the metal, it seemed desirable that we in Ireland should make the necessary crucial experiments. Hence, about seven years ago, I commenced to collect the crude Irish beryls or "emeralds," and ultimately succeeded in obtaining 3 kilogrammes of the dressed mineral, from which I prepared nearly 350 grms. of the pure glucinic oxide.

I have to thank my friend Mr. William Harte, C.E., the excellent County Surveyor of Donegal, for the valuable assistance he kindly afforded me in collecting much of the mineral from which the glucinic oxide was prepared.

The satisfactory nature of the results of a set of preliminary experiments with the material at my disposal must be my apology for laying a short communication upon the subject before the Academy at a very early stage of the investigation.

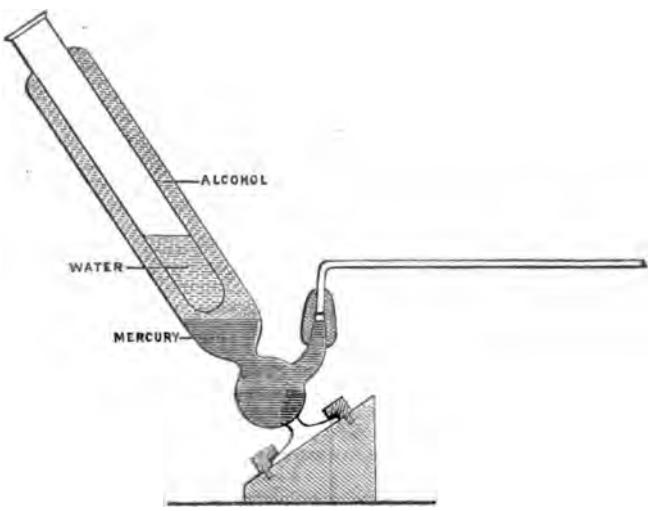
Some glucinic oxide was converted into the anhydrous chloride by the action of chlorine upon it at a full red-heat in presence of finely divided carbon; and the metal was subsequently procured by the action of metallic sodium on the pure sublimed glucinic chloride. The reduction was effected by heating a suitable mixture in a platinum vessel; but the temperature was not allowed to rise sufficiently to liquefy the mass; and on removal of the material from the crucible, those portions which had been in contact with the platinum were rejected. The resulting mixture of sodic chloride and reduced glucinum was then fused under common salt in a lime crucible; this precaution was taken in order to avoid contact with siliceous com-

* Read before the Royal Irish Academy, April 10, 1876.

pounds. Considerable loss occurred in this operation; but I succeeded in obtaining a small coherent mass of metallic glucinum, which latter was found to agree in characters with the metal described by Debray,* though that distinguished chemist effected the reduction of his metal in a different manner.

If we admit, with Awdejew and with Debray, the number 4·6 to be the equivalent of glucinum (H = 1), the question remains whether the atomic weight, so-called, is a multiple of the equivalent by 2 or 3.

If, as some assert, the atomic weight is $4·6 \times 3 = 13·8$, the only known oxide of glucinum must resemble alumina. If, on the other hand, the atomic weight is $4·6 \times 2 = 9·2$, glucina must be an oxide like that of zinc or of magnesium. Each view has received the support of a group of chemists of the highest eminence; but, owing to peculiar difficulties surrounding the case, an appeal to chemical criteria has hitherto been insufficient to decide between the two conflicting opinions—a determination of the specific heat of the metal, or of the vapour-density of one of its compounds of simple constitution, being necessary for the final settlement of the question. Of these methods I chose the former; and having made several determinations of the capacity for heat of metallic glucinum, I have the gratification to state that the data obtained lead to the conclusion that the atomic weight of glucinum is double the equivalent weight. Glucinum is therefore a diatomic metal with an atomic weight of 9·2—though, I may add, this number may be slightly affected by a new determination of the equivalent, in which I am engaged.



The method pursued in making the necessary determinations upon which to found the conclusion just stated was devised for the purpose of this inquiry; and as it is essentially different from any with which I am acquainted, I may be permitted to indicate very briefly the plan adopted after a good deal of preliminary investigation.†

The well-known law of Dulong and Petit, as modified by Cannizaro, asserts that the atoms of elementary matter have the same capacity for heat, when we compare them to the solid state. The outstanding exceptions to this important law are few; and even these appear to have been cleared away in some degree by the recent researches of Weber on the specific heats of silicon, boron, and carbon. The principle, however, is admittedly sufficiently general in its application to enable us to found upon it a plan for the determination of the atomic weight, so-called, of a particular element; for it is evident that if we employ as a standard a metal whose atomic weight and specific heat are both accurately known—silver for example (= 108)—the weight of another solid element, which contains the same quantity of heat at 100° C. as 108 parts of pure silver at 100° C., is the atomic weight of the element. In seeking to compare glucinum with pure metallic silver in this way, I succeeded in arranging an experimental method which not only enabled me to attain the object I had in view, but also to demonstrate the truth of the law just referred to. The apparatus required is easily constructed, and consists of a spirit-thermometer with a cylindrical "bulb" in which a test-tube is sealed, after the manner of Bunsen's ice-calorimeter. This part of the apparatus can be conveniently made from a small chloride of calcium drying-tower, as shown in the diagram. Although the larger "bulb" of the thermometer is full of spirit, the lower one and the stem are full of mercury, and connected with a fine capillary tube carefully graduated in millimetres, and calibrated. The arrangement constitutes an exceedingly delicate spirit-thermo-meter, with a mercury index.

When it desired to compare a solid element with silver, in order to fix the atomic weight, it is necessary to make a preliminary experiment with the standard metal. For this purpose one cubic centimetre of distilled water is placed in the test-tube, which is immersed in the bulb of the thermometer; and when the temperature has been equalized, and the thread of mercury has reached a suitable position in the stem a piece of pure silver weighing 108 centigrammes and heated to 100° C. in steam, is rapidly dropped into the cubic centimetre of water, and the expansion caused in a given time carefully noted.*

According to the law above stated, a centigramme atom, if I may use the term, of any other metal than silver, ought to cause exactly the same expansion when the experiment is made with it under precisely the same conditions; and these conditions are very easily realised. I have ascertained that such is the case; and the approxi-

* *Annales de Chemie et de Physique*, troisième série, tom. xliv., p. 5 (1855).

† The preparation of pure metallic glucinum in quantities exceeding 2 or 3 grms. is difficult and costly. For this amongst other reasons I determined to employ Bunsen's admirable and theoretically perfect ice-calorimeter in the estimation of the specific heat of the metal, as small quantities of material only are required. It proved, however, to be impossible, owing to various engagements, to prepare the glucinum in a state of sufficient purity until the season had passed when Bunsen's ice-calorimeter can be conveniently used. I had therefore to devise a calorimetric method which could be employed during the warm weather, and which could afford trustworthy results with small weights of material. I have given in the text an outline of this method; but the details of its application to the determination of atomic and molecular heat will form the subject of another communication.

* The apparatus is carefully protected from the influence of air currents during an experiment.

mate equality in "atomic heat" of many of the metals has thus been easily demonstrated.

The comparison of glucinum with silver was made on this plan; and it was found that the weight of glucinum which contains nearly the same quantity of heat at 100° C. as 108 centigrammes of silver at the same temperature is not 4·6 or 4·6×3, but 4·6×2, or 2·2 centigrammes.

The "atomic heat" of silver, or the product of the specific heat (=0·05701 according to Regnault) into the atomic weight (=108), is 6·157. Using this number as the standard for reference, the experimental number found for the atomic heat of the specimen of glucinum operated with is 5·91. Thus:—

Atomic heat of silver . . =6·157
Atomic heat of glucinum . =5·910

The difference is less than the known difference between the atomic heat of silver and that of aluminum; but I am inclined to think that the lower number found for the glucinum used is due to the presence of a little platinum in the specimen of metal. Owing to the high atomic weight of platinum (=197·1) as compared with that of glucinum (9·2), the presence of even a small quantity of the former metal must very sensibly affect the determination of the atomic heat of glucinum. I hope soon to be in a position to continue these experiments with the *pure* metal.

It will, however, appear from the following considerations that we may fairly regard the above determination of the atomic heat of glucinum as being of such value as to enable us, even at an early stage of the enquiry, to use it as a physical control, and to fix the atomic weight of the metal, subject of course to the probably small change in the numerical expression which may prove to be necessary as the investigation proceeds.

If we assume the atomic weight of glucinum to be 9·2, and employed the value I have obtained for the atomic heat *i.e.*, 5·91, we can calculate the specific heat of the metal by means of the formula—

$$S=\frac{H}{A}, \quad \ldots\ldots\ldots \quad (1)$$

when S represents the specific heat, H the atomic heat, and A the atomic weight of an element. The specific heat of glucinum thus calculated is 0·642.

If now we substitute for H a constant, which in this case is the product of the well-ascertained atomic weight of silver† into its equally well-determined specific heat, AS=6·157, the expression becomes—

$$S=\frac{6\cdot157}{A}; \quad \ldots\ldots\ldots \quad (2)$$

and with its aid we can calculate the specific heat of any solid element, if its atomic weight is known or assumed. I have thus calculated the specific heat of glucinum on the assumption (*a*) that its atomic weight is 9·2, (*b*) that its atomic weight is 4·6, and (*c*) that it is 13 8.

The results are compared in the following table with the specific heat obtained by calculation from the actual determination of the heat of the metal:—

Specific heat of glucinum calculated (1) from the result of determination of atomic heat—

A=9·2 . . . . . 0·642.

Specific heat of glucinum calculated by (2).—

When A= 9·2 . . . . . 0·669
When A= 4·6 . . . . . 1·338
When A=13·8 . . . . . 0·446.

I am therefore justified in concluding that the atomic weight of glucinum is nearly if not exactly 9·2.

† We might obviously take any other product; but that of silver is here preferred because the atomic heat of that metal has been employed as the standard for reference.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 15th, 1877.

Professor ABEL, F.R.S., President, in the Chair.

THE visitors having been announced and the minutes of the preceding meeting read and confirmed, the names of Messrs. Carl T. V. Buch, H. Senier, S. G. Thomas, J. H. Poland, and J. Y. Buchanan were read for the first time. Mr. Frank W. Young was elected after his name had been read the third time.

The first paper "*On Isomeric Nitroso-Terpenes*," by Dr. W. A. TILDEN and Mr. W. A. SHENSTONE, was read by the SECRETARY. After alluding to the former paper by Dr. Tilden on the same subject, the authors described the methods they now employ for the preparation of the nitroso-chlorides of the terpenes, and which consists in passing gaseous nitrosyl-chloride into a well cooled mixture of the terpene with chloroform or with ordinary spirit, when the new compounds usually separate in the crystalline state. In this manner nitroso-chlorides have been obtained with the terpenes from both dextro- and lævo-gyrate turpentine oils, from oil of sage, and from oil of juniper; it is an important fact that although all these terpenes differ widely in their action on polarised light and in their other physical properties, yet the nitroso-derivatives, obtained by the action of alcoholic potash on the nitroso-chlorides are all without action on polarised light, melt at the same temperature, and agree apparently very closely in their crystalline forms. The nitroso-chlorides of that class of terpenes, boiling at about 175°, of which hesperidene, from orange peel oil, is a type, were also examined; crystalline compounds being obtained from hesperidene, oil of caraway, bergamot, and with some difficulty from essence of lemon. The nitroso-chlorides from the two first when carefully heated in small quantities at a time yielded crystalline nitroso-derivatives, although none could be obtained by the process found to answer so well with the terpenes of the first class, namely, treatment with alcoholic potash. The authors believe that this method will not only serve to discriminate the different isomeric terpenes, but also to show that a large number of the natural terpenes are merely physical isomerides and not distinct chemical compounds.

Prof. MASKELYNE said he was engaged in examining the crystalline forms of the substances described in this paper, but the investigation was not yet completed. He might say, however, that the crystals from the first group of terpenes, although at first sight they appeared very different, seemed really to belong to one and the same system. The crystals from hesperidene and caraway were very simple, and had very few faces to them, but he believed they belonged to a different system from the other group.

The PRESIDENT, having thanked the authors,

Dr. J. H. GLADSTONE read a paper by himself and Mr. A. TRIBE on the "*Preparation of Copper-Zinc Couples.*" The object of the numerous experiments detailed in this paper was to ascertain the best formula for the preparation of the couple; and for this purpose it was necessary to ascertain the influence exerted both by the proportion of copper deposited on the zinc foil, and also by its state of aggregation, the latter varying with the strength of the solution of copper sulphate employed to attack the zinc. The results showed that the couple of maximum activity was obtained by depositing the copper from a 2 per cent solution of the sulphate in six successive depositions, if it was to be employed in the decomposition of water, or for preparing ethyl hydride from a mixture of alcohol and ethyl iodide. For dry couples, however, such as those used in the preparation of the organo-zinc compounds and similar

eactions, one deposition from a 2 per cent solution was found to be most effective. The activity of these couples, rom the results of experiments instituted with that object, was ascertained to be more than 1000 times greater than that of pure zinc. This paper was illustrated by numerous experiments.

The PRESIDENT said the authors had brought before them so many interesting results during the last few years, in connection with the copper-zinc couple, that their best thanks were due to Dr. Gladstone and Mr. Tribe for the lucid and precise details they had given them that evening as to the best way of making the most effective couple.

In reply to a question by Dr. WRIGHT as to whether other copper salts had been tried for the preparation of the couple, and, if so, whether the conditions of maximum activity were the same,

Dr. GLADSTONE said experiments had been made with other salts of copper, but not quantitatively, the object being to ascertain the best way of making the most active couple, therefore copper sulphate had been used as being most convenient.

Mr. KINGZETT said that Dr. Paul, who had used the copper-zinc couple for estimating nitrates and nitrites in water, had found a great difference in the results obtained with couples prepared with solutions of copper sulphate of different strengths.

Mr. E. RILEY then gave a short account of "*Chromium Pig-Iron*." A quantity of pig-iron, which has recently been made in Australia, instead of having the ordinary qualities of pig-iron, was found to be exceedingly hard, and to present the appearance of the specimen exhibited. The ore employed in the manufacture had been analysed in this country by six or seven different chemists, all of whom, with one exception, had overlooked the presence of chromium, which might perhaps be accounted for by the fact that the specimen of ore sent over contained but a mere trace of chromium. The pig-iron from this ore, however, contained 6 to 7 per cent of chromium, as might be seen from the analysis given of two samples:—

	I.	II.
Chromium	6·984	6·287
Carbon	4·418	4·200
Silicon	1·460	0·976
Sulphur	0·102	0·207
Phosphorus	nil	0·055
Iron	—	88·343
Manganese	0·125	nil

From this it could readily be seen that the relation between the amount of carbon and sulphur was quite abnormal. As some 1200 tons of this iron had been manufactured it was important to know what to do with it. It had been stated that chromium plays the same part as manganese in iron, but in experiments made to ascertain if this chromium pig-iron could be substituted for spiegeleisen in the manufacture of Bessemer steel, very unsatisfactory results were obtained, the steel breaking up under the hammer. When mixed with one-half hæmatite and puddled it melts with difficulty, but although the chromium soon goes out in the cinder, the iron produced would not weld.

The PRESIDENT said Mr. Riley's communication possessed considerable interest, but he himself should have considered it very unlikely that this chromium iron would play the part of spiegeleisen. He had examined a specimen of the so-called chromium steel, but had found a mere trace of chromium in it. It was possible, however, that the chromium exerted a function in the production of the steel, but was eliminated at some stage in the process, so that it did not appear in the finished steel.

Mr. RILEY, in answer to some remarks on the subject, expressed his opinion that the colour test, although it could be depended on for the determination of the amount of carbon in steel, was very untrustworthy when applied to iron, the determination of the carbon by combustion after removal of the iron being the most reliable. He had found that the chromium had dissolved with the iron during the ordinary treatment for analysis.

Mr. C. E. GROVES then read a "*Note on Gardenin*," by Dr. J. STENHOUSE and himself. Gardenin was discovered by one of the authors some twenty years ago in "Dekamali gum," an Indian drug, but the quantity obtained at that time was too small for analysis. Recently, however, they have obtained a larger specimen of the resin and extracted the gardenin from it. It crystallises in deep yellow needles, which melt at about 164° and are somewhat difficult to purify. The results of the analysis agree very well with the formula $C_5H_5O_2$, which requires 61·86 per cent carbon and 5·15 hydrogen, whilst the numbers obtained by Flückiger were 59·47 carbon and 6·71 hydrogen. It is probable, however, that the specimen he analysed, and which melted at 155°, was contaminated with a colourless fatty substance of low melting-point present in the resin, and which is not entirely removed even by repeated crystallisation from spirit. The authors find when gardenin is dissolved in glacial acetic acid, and carefully treated with nitric acid in the cold, that a red crystalline substance is formed which melts at about 236°. It crystallises in long needles, which are insoluble in water, and almost insoluble in alcohol. As it is insoluble in dilute acids, but soluble in dilute alkaline solutions, from which it is re-precipitated on the addition of an acid, it has been provisionally named *gardenic acid*. The authors hope soon to be in possession of a large quantity of dekamali gum, which will enable them to continue this investigation. A note on ginger was appended to this paper, in which it is shown that the resin in ginger when fused with an alkaline hydrate yields proto-catechuic acid.

After the PRESIDENT had thanked the authors in the name of the Fellows,

The SECRETARY read two papers by Mr. M. M. P. MUIR, the first of which was an "*Additional note on a Process for Estimating Bismuth Volumetrically*," in which the author gives a modification of his former process; he now precipitates the acid solution of bismuth nitrate with excess of sodium acetate, dissolves the precipitate by means of a slight excess of acetic acid and titrates with a standard solution of potassium dichromate. The second paper was "*On Certain Bismuth Compounds, Part IV.*," in which a chromate of bismuth, $3Bi_2O_3,2CrO_3$, is described as obtained by the action of a hot potash solution on the chromate, $3Bi_2O_37CrO_3$. The formation of the compounds $Bi_2O_5xH_2O$ and $Bi_2O_4xH_2O$, by the action of chlorine on bismuthous oxide suspended in a hot solution of potassium hydrate, is then considered, and it is also shown that the oxide, Bi_2O_5,H_2O, when dissolved in an acid and precipitated with an alkali, always yields bismuthous hydrate, $Bi_2O_3xH_2O$, whether the solution has been previously subjected to the action of reducing agents or not. The author concludes this part of his paper by discussing the formulæ of the six known hydrates of bismuth. There is an addendum on the action of potassium ferrocyanide on bismuth solutions, from which it appears that in presence of nitric acid bismuth ferrocyanide, $Bi_{45}FeCy_6$, is first produced, quickly passing, however, into the ferricyanide, $Bi_{35}FeCy_6$, which, in turn, undergoes decomposition with evolution of hydrocyanic acid.

The concluding paper "*On the Determination of Urea by Means of Hypobromite*," by Dr. M. SIMPSON and Mr. C. O'KEEFFE, gives a description of a form of apparatus devised by them, of which it would be very difficult to give an intelligible account without reproducing the drawing which accompanies it. It does not seem to be so convenient for hospital practice, however, as that recently described by Dr. Dupré.

The meeting was then adjourned until Thursday, the 29th March, the Anniversary. The next ordinary meeting will be on Thursday 5th April, when Professor Nevil Story Maskelyne will deliver a lecture "On the Discrimination of Crystals by their Optical Characters."

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

March 12th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

AT the opening of the session Prof. Hofmann paid a short tribute to the memory of Frederick Varrentrapp, whose death at Brunswick, in his sixty-second year, has lately been announced. Varrentrapp rendered his chief services to chemistry in his younger years, and his name is best known as associated with that of Liebig's in extensive researches on the fatty series, and with that of Will in the familiar apparatus for the determination of nitrogen in organic bodies. Of late years he had devoted himself almost exclusively to industrial chemistry.

Prof. OPPENHEIM delivered an address upon the late Brussels Exhibition of Life-saving Apparatus, &c., in its chemical connections.

Prof. LIEBERMANN and F. GIESSEL described "*Some Derivatives of Chinizarin.*" The preparation from phenol chloride and phthalic anhydride has been found to yield the best results. By the action of hydriodic acid and phosphorus as reducing agents chinizarin,—

$$C_6H_4\begin{Bmatrix}CO\\CO\end{Bmatrix}C_6H_2(OH)_2,$$

gave as the first product—

$$C_6H_4\begin{Bmatrix}C(OH)H\\C(OH)H\end{Bmatrix}C_6H_2(OH)_2,$$

crystallising in the form of yellow needles, dissolving in alkalies with a yellow colour, and capable of being changed back to chinizarin by simple exposure to the oxidising effect of the air. The second product is—

$$C_6H_4\begin{Bmatrix}C(OH)H\\CH_2\end{Bmatrix}C_6H_2(OH),$$

also consisting of yellow needles, and the third and final product—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2(OH)_2,$$

which is obtained pure in the form of the potassium salt, possesses a slightly acid reaction, and shows all the properties of a phenol. Although not entering into combination with ammonia, it dissolves easily in ethylamin, forming—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2\begin{Bmatrix}N(C_2H_5)H\\OH\end{Bmatrix}$$

which separates out in the form of yellow needles. Oxidation changes it into—

$$C_6H_4\begin{Bmatrix}CH_2\\CH_2\end{Bmatrix}C_6H_2<\begin{matrix}O\\O\end{matrix}>O.$$

A. MICHAEL and T. H. NORTON described a new acid, "*Diamido-sulpho-benzide-dicarbonic acid,*"

$$SO_2<\begin{matrix}C_6H_4<\begin{matrix}NH_2\\COOH\end{matrix}\\C_6H_4<\begin{matrix}COOH\\NH_2\end{matrix}\end{matrix}$$

obtained by the action of weak fuming sulphuric acid upon paramido-benzoic acid at 170°. It does not melt below 350°, and crystallises easily from water, but is not easily soluble in alcohol, ether, and other solvents. It forms with sulphuric acid a very soluble compound, and yields finely crystallising metallic salts, those with lead and silver being especially insoluble. This is the first sulphon containing a carboxyl group, which has been so far prepared, and was obtained under very nearly the same conditions by which metamido-benzoic acid yields a sulphonic acid. The authors found in the preparation of paramido-benzoic acid, from para-nitro-toluen, that a very dilute solution of potassium permanganate was much better adapted for purposes of oxidation than the methods hitherto in use. During the process of reduction with tin and hydrochloric acid it was also observed that paramido-benzoic acid, when heated with $SnCl_2$ at 120°, was entirely decomposed into carbonic acid and aniline.

A. MICHAEL and A. ADAIR gave the results of experiments on the formation of "*Aromatic Sulphons,*" leading to the adoption of the following as a general method of preparation. If sulphonic acid be mixed with an excess of an aromatic hydrocarbon and phosphoric andydride, and heated in a closed tube for a number of hours at 150° to 200°, the corresponding sulphon is formed, although in not very large quantities. Experiments were tried with benzen-sulphonic acid and toluen, para-toluen-sulphonic acid and toluen, and para-toluen-sulphonic acid and benzen. The mixed sulphons of benzen and naphthalin obtained in this way were studied more particularly. Benzen-snlphonic acid and naphthalin yield two isomeric sulphons with the formula—

$$SO_2<\begin{matrix}C_6H_5\\C_{10}H_7\end{matrix}.$$

The *a*-sulphon melts at 100°, and forms white rhomboidal crystals. The *β*-sulphon separated from the other by treatment with alcoholic ether melts at 115°, and crystallises in needles. Benzen and *β*-naphthalin-sulphonic acid yield a single sulphon, coinciding in properties with the *β*-sulphon from benzen-sulphonic acid. The isomers are both very insoluble in water. The identity of the compounds obtained by the two processes furnishes additional strength to the theoretical considerations with regard to the hexavalence of sulphur in sulphuric acid.

W. KLOBUKOWSKI communicated the results of experiments "*On the Constitution of Rufigallic Acid.*" An acetyl compound was prepared, and shown by analysis to be a hexacetyl-rufigallic acid. By treatment with methyl iodide and ethyl iodide in the presence of potassic hydrate at 130° tetra-methyl and tetra-ethyl derivatives of rufigallic acid were obtained, which, upon further treatment with the iodides, were changed into the hexa compounds. All of these derivatives possess remarkably fine crystalline forms. They are regarded by the author as proofs of the existence of six hydroxyl groups in rufigallic acid, and as this acid, as well as the compounds obtained by him from it, yield anthracen directly by reduction with zinc, he considers it to be a hexa-oxy-anthraquinon. The formation from gallic acid would then be as follows:—

$$2C_6H_2(OH)_3COOH = 2H_2O + OC[C_6H(OH)_3]_2CO.$$

The following papers have been communicated by non-resident members:—

H. LIMPRICHT, "*Replacement of* Br *and* SO_3H *by* H *in the Benzen-sulphonic Acids.*" The author has studied various reactions adapted for the reduction of the more highly substituted benzen derivatives to simpler forms, with the view of controlling their proposed rational formulæ. Concentrated HCl and phosphorus are found to be the best reagents for the gradual replacement of bromine by hydrogen in such compounds. Amido-benzen-sulphonic acid, $C_6H.Br_3.NH_2.SO_3H$, subjected to this treatment for several hours at 140° yields a mixture of $C_6H_2.Br_2.NH_2.SO_3H$, $C_6H_3Br.NH_2.SO_3H$, and—

$C_6H_4.NH_2.SO_3H$.

The methods hitherto in use have produced an entire reduction, and have not permitted a study of the possible intermediate products. In most substituted benzen-sulphonic acids SO_3H can be replaced by H simply by heating with concentrated HCl, the bromo-benzen-sulphonic acids being changed into bromo-benzens, the brom-amido-benzen-sulphonic acids into bromo-anilines, &c.

H. BAHLMANN has prepared a number of "*Derivatives of Ortho-amido-benzen-sulphonic Acid.*" Among these are the mono- bromo- and dibrom-amido-benzen-sulphonic acids, and the orthiodo-, orthochloro-, and ortho-bromo-benzen-sulphonic acids. From the latter a nitro-bromo-benzen-sulphonic acid, $C_6H_3.NO_2.Br.SO_3H$ (1, 4, 5), was obtained by treatment with HNO_3. A number of salts and the amido-bromo-benzen-sulphonic acid obtained by reduction with tin and HCl are described.

B. RADZISZEWSKI, "*On some Phosphorescent Organic Bodies.*" Grape-sugar, when dissolved in an alcoholic solution of caustic potash and submitted to the action of a stream of oxygen, exhibits the same phenomenon of phosphorescence shown by lophin, paraldehyd, furfurin, and other polymeric aldehyds or NH_3 derivatives of aldehyds, when exposed to oxidising influences under the same circumstances. This fact furnishes additional proof for the aldehyd nature of grape-sugar. Formic aldehyd exhibits also phosphorescence under similar conditions while changing into formic acid.

A. BAEYER, "*On Furfurol.*" The author has obtained previously among the condensation products of furfurol and various phenols, green substances strongly resembling chlorophyll. Experiments show that the colour is not due to the presence of an aromatic group, as furfuric alcohol itself gives the colouration when treated with HCl. In pursuing the subject furfurol was treated according to Perkin's reaction, with acetic anhydride and sodium acetate. The result was furfuracrylic acid:—

$$C_4H_3O.CHO+CH_3.CO.OH = \cdot$$
$$=C_4H_3O.CH.CH.COOH+H_2O.$$

The new acid, which is isomeric with salicylic acid, melts at 135°, possesses a cinnamonic odour, and is volatile. Concentrated HCl dissolves it under formation of a stable green colour, and H_2SO_4 yields a green condensation product. Reduction with sodium amalgam yields furfurpropionic acid, $C_7H_8O_3$, melting at 50°, forming with HCl a reddish yellow solution, possessing the odour of furfuracrylic acid, but much more soluble in water.

W. WEITH, in the course of experiments "*On the Constitution of Carbo-triphenyl-triamine,*" finds that the following is the only decomposition resulting from treatment with HCl or HKO:—

$$CN_3H_2(C_6H_5)_3+2H_2O=CO_2+3C_6H_5NH_2,$$

that H_2SO_4 neither gives the bright blue colour peculiar to bodies containing $N(C_6H_5)_2$, nor forms diphenyl-aminsulphonic acid, yielding instead sulphanilic acid, that carbo-triphenyl-triamine is not changed under any circumstances to α-triphenyl-guanidin, and that it finally by distillation is decomposed into aniline, ammonia, hydrocyanic acid, diphenylamin, and benzonitrile. From these facts he regards carbo-triphenyl-triamine as a symmetrical triphenyl-guanidin—

$$\begin{matrix} NHC_6H_5 \\ CNC_6H_5 \\ NHC_6H_5 \end{matrix}$$

C. BÖTTINGER, "*Action of Ammonia and Amido-Derivatives upon Pyroracemic Acid.*" Alcoholic ammonia yields a new acid, $C_8H_9NO_4$, which has been named uvitoninic acid. By the action of anthranilic acid upon pyroracemic acid a mixture of condensation products was obtained.

E. MULDER, "*On the Mono-molecular Unit of Volume for Gases and Vapours.*" The author favours from various theoretical considerations the adoption of 0·5 as the atomic weight of hydrogen, in order to give more simplicity to the expression for Avogadro's law, replacing $M=2\delta$ by $M=\delta$.

H. W. VOGEL, "*Spectroscopic Notes.*" The author has discovered that thin sections of garnets yield quite distinct absorption spectra, consisting of a broad band in the green portion of the spectrum, between *b* and F, a less prominent one between D and E, and a weak one between E and *b*. Ruby displays a single band between E and D. It is suggested that this property be made use of for the detection of the precious stones. In order to remove the alkaline bands apparent in the spectrum of purpurin when dissolved in pure water before proceeding to test for magnesia, the addition of a few drops of chloride of ammonium is found sufficient. The use of potassic tartrate for the precipitation of lime from solutions to be tested for Mg is regarded unfavourably on account of the frequent presence of Mg in the tartrate; precipitation with ammonium chloride and carbonate is preferred. In order to test for aluminium by the purpurin reaction, when iron salts are present, the latter are oxidised, the solution is treated with KSCN, and the ferric sulphocyanide thus formed is removed by shaking with ether.

K. STUCKENBERG, "*On Benzoyl Derivatives of Ortho-para-amido-phenol.*" The hydrochlorate of this α-diamido-phenol when treated with benzoyl-chloride, yields tribenzoyl-α-diamido-phenol—

$$C_6H_3.N(CO.C_6H_5)_2.NH(CO.C_6H_5).OH,$$

and dibenzoyl-α-diamido-phenol,—

$$C_6H_3.(NH.CO.C_6H_5)_2.OH.$$

The latter crystallises in triclinic columns, which show all the peculiar properties of felspar in polarised light.

"*On α-Amido-nitro-phenol, its Benzoyl Derivative, and an Amido-dinitro-phenol.*" The author obtains α-amido-nitro-phenol from α-dinitro-phenol by subjecting the alcoholic solution to the action of H_2S and $NH_4.SH$. By treatment with benzoyl-chloride benzoyl-α-amido-nitro-phenol was obtained, and from this by the action of HNO_3 the author prepared nitro-benzoyl-α-amido-nitro-phenol, $C_6H_2.(NO_2)_2.NH(CO.C_6H_5).OH$, which, by reduction, gives an amido-dinitro-phenol,—

$$C_6H_2.(NO_2)_2.NH_2.OH,$$

apparently identical with picraminic acid.

"*On β-diamido-Phenol, its Benzoyl Derivatives, and β-amido-nitro-phenol.*" β-diamido-phenol results from the reduction of diortho-nitro-phenol with Sn and HCl. Treatment with benzoyl-chloride yields a mixture of dibenzoyl, tribenzoyl, and tetrabenzoyl-β-diamido-phenol. β-amido-nitro-phenol is obtained from β-dinitro-phenol by the action of H_2S and $NH_4.SH$.

NOTICES OF BOOKS.

Disinfection in Yellow Fever, as practised at New Orleans in the Years 1870 to 1875 inclusive. By C. B. WHITE, M.D. New Orleans: Maddon.

AMONGST the epidemics recognised by modern medical science, yellow fever—ravaging as it does almost all parts of the world endowed with a genial climate—holds a very prominent place, and any proved method of checking its spread merits careful attention. It appears tolerably well established that the poisonous agent of this disease is not gaseous in its nature, but attaches itself to the soil, to walls, and surfaces in general. "If this poisonous cause be organisms, either animal or vegetable, they seem to be low-lying, propagating from centres along surfaces equally in all directions, against the wind as well as in the direction of the air-currents." The speed with which the infection travels has been observed to be about 40 feet per day. If, therefore, we take the number of days that a patient has been sick, add four for the number of days of "incubation," and multiply the sum by 40, we shall have the radius in feet of the area which is probably or possibly infected. Under such circumstances disinfection is obviously much more practicable than in case of a gaseous or volatile poison. The agent selected has been the mixture of carbolic and cresylic acids, preferably in the crude state; and it is very satisfactory to learn that, when properly applied, this disinfectant has proved successful in limiting the spread of the pestilence. It will be understood, however, that no half-measures can be satisfactory. The tarry acids must be applied liberally and thoroughly, and even more widely than theory would seem to indicate. The cases described in this pamphlet are exceedingly interesting, and certainly support the author's views. Sulphurous acid and chlorine, used of course separately, have also been found serviceable.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JANUARY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·007	0·120	0·135	18·90	7·390	0·288	0·87	2·060	13·2	3·8
West Middlesex	Slightly turbid	0·000	0·008	0·150	0·133	18·40	7·560	0·252	0·94	1·860	13·2	3·8
Southwark and Vauxhall	Slightly turbid	0·001	0·006	0·105	0·138	19·00	7·500	0·252	0·87	1·730	13·2	3·8
Chelsea	Slightly turbid	0·007	0·009	0·150	0·120	18·80	7·160	0·180	0·94	1·860	13·2	2·9
Lambeth	Slightly turbid	0·006	0·009	0·210	0·094	20·90	8·170	0·504	1·01	2·260	14·8	4·2
Other Companies.												
Kent	Slightly turbid	0·000	0·003	0·300	0·003	27·90	11·200	0·432	1·51	3·460	20·6	6·0
New River	Slightly turbid	0·000	0·006	0·216	0·094	20·50	8·560	0·216	0·87	1·530	14·9	3·3
East London	Slightly turbid	0·001	0·008	0·150	0·079	22·70	8·230	0·468	1·01	2·460	14·9	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

CORRESPONDENCE.

ESTIMATION OF UREA.

To the Editor of the Chemical News.

SIR,—My answer to Mr. Apjohn's letter in the CHEMICAL NEWS, vol. xxxv., p. 114, is simple, but more than sufficient. Let Mr. Apjohn read my paper when it appears, and he will find that in this case he has not followed the old adage which teaches us not to cry out before we are hurt.—I am, &c.,

A. DUPRÉ.

estminster Hospital, March 19, 1877.

OXIDISING ACTION OF ANIMAL CHARCOAL UPON ORGANIC MATTERS.

To the Editor of the Chemical News.

SIR,—In answer to the interesting note published in the CHEMICAL NEWS, vol. xxxv., p. 114, by Mr. Robert F. Smith, I have not made any analyses of the mixture of prussiate-char and night-soil either when freshly mixed or afterwards, but undoubtedly a large proportion of the ammonia produced would be lost by evaporation into the atmosphere. The points which Mr. Smith suggests would form an interesting subject of investigation, but no reliable results could have been obtained from such an immense heap of such varied organic matters as the one from which I collected the sample of drainage.—I am &c.,

WILLIAM THOMSON.

Royal Institution, Manchester, March 20, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 9, February 26, 1877.

Effects of a Jet of Air in Water, and on the Suspension of Water in Air: Suspension and Ebullition of Water on a Tissue with Wide Meshes.—M. F. de Romilly.—This paper requires the aid of the accompanying engravings.

Functions of the Leaves in the Phenomena of Gaseous Interchange between Plants and the Atmosphere; Part Played by the Stomata.—M. A. Merget.—It is concluded that the gases tried, however different in their properties, are diffused through the orifices of the stomata with an equal facility in both directions.

Fourth Note on the Theory of the Radiometer.—Extract from a letter of Mr. W. Crookes to M. Th. du Moncel.—The *Comptes Rendus*, January 5, 1877, contains a note by MM. Bertin and Garbe, in which it is said that I have opposed the views of Dr. Schuster regarding the nature of the force producing the movement of the radiometer. So far from opposing Dr. Schuster's views, my experiment "On the Movement of the Glass Case of a Radiometer," described to the Royal Society on March 30, 1876, fully corroborates his experiments. In a communication I had the honour of presenting to the Academy of Sciences on December 11, 1876, I brought forward experimental proof that the presence of residual gas is the cause of the movement of the radiometer, and generally of the repulsion resulting from radiation, the maximum effect being at a pressure of about 50-millionths of an atmosphere. As I have stated in a postscript to my papers, read before the Royal Society more than twelve months ago, and which are now being published in the *Philosophical Transactions*, the explanation afforded by the dynamic theory of gases shows very clearly how it was that I obtained such strong actions in my earlier experiments when using white pith as the material to be repelled, and employing the finger as a source of heat, and how it happened that I did not discover for some time that dark heat and the luminous rays were essentially different in their actions on black and white surfaces. The explanation of this is as follows:—Rays of high intensity (light) pass through the walls of the glass vessel without warming it; they then, falling on the white surface, are simply reflected off again; but falling on the black surface they are absorbed, and, raising its temperature, produce the molecular disturbance which causes motion. Rays of low intensity (dark heat) do not, however, pass through the glass to any great extent, but are absorbed and raise its temperature. This warmed spot of glass now becomes the repelling body

through the intervention of the molecules rebounding from it with a greater velocity than that at which they struck it. The molecular pressure, therefore, in this case streams from the inner surface of the warm spot of glass on which the heat rays have fallen, and repels whatever happens to be in front of it, quite irrespective of the colours of its surface.

Action of Water upon the Chlorides of Iodine.—M. P. Schützenberger.—If the chlorides of iodine are not decomposed into hydrochloric acid, iodic acid, and free iodine, it is because the direction of the reaction is modified by the existence of a compound of hydrochloric acid and of protochloride of iodine permanent in presence of water.

Formation of Quinons by means of Chloro-chromic Acid.—M. A. Etard.—Nitro-quinon, $C_6H_3(NO_2)O_2$, has been obtained by causing 1 part of chloro-chromic acid to react upon 3 parts of benzol, placed in a flask fitted with an ascending refrigerator. The reaction is complete when hydrochloric acid no longer escapes.

Saccharine Matter Extracted from the Leaves of the Nut Tree.—MM. Tanret and Villiers.—Nucite is represented by the formula $C_{12}H_{12}O_{12}+2H_2O_2$.

Salts of the Algerian Salt Marshes.—These salts contain chloride of sodium and sulphate of soda.

Experiments on Acute Poisoning by Sulphate of Copper.—MM. Feltz and Ritter.—An account of experiments performed on frogs, pigeons, rabbits, and dogs, which in this country would be pronounced an "orgie of diabolism." The authors conclude that sulphate of copper will not be willingly taken in quantities sufficient to cause death.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 2, January 11, 1877.

M. Maiche, in the preparation of rice-starch, makes use of a centrifugal machine, by which the water, the starch, and the cellulose are respectively separated from each other.

The Radiometer.—J. Delsaulx.—The author regards the radiometer, not as a thermic, but as a thermo-electric apparatus.

No. 3, January 18, 1877.

M. Littré is taken gravely to task for having, in his great dictionary of the French language, spelt "granit" without the final "e," "in imitation of the English and the Germans." The writer is mistaken as regards the English orthography of the word.

No. 4, January 25, 1877.

This issue does not contain any chemical matter.

NOTES AND QUERIES.

Products of Rosin Distillation.—Could any of your readers give me information on the above, saying the quantities of the two oils obtained from rosin on the manufacturing scale, and also state what are the uses of these oils?—Rosin.

MEETINGS FOR THE WEEK.

Monday, 26th.—London Institution, 5.
—— Medical, 8.
—— Society of Arts, 8. (Cantor Lectures). "Chemistry of Gas Manufacture," A. Vernon Harcourt, F.R.S.
—— Royal Geographical, 8.30.
Tuesday, 27th.—Civil Engineers, 8.
—— Anthropological Institute, 8
—— Society of Arts, 8, (African Section). "The Best Trade Route to the Lake Regions of Central Africa," by Edward Hutchinson.
Thursday, 29th.—London Institution, 7.
—— Chemical, 8. (Anniversary).

TO CORRESPONDENTS.

A Long Subscriber.—Every aniline dye requires different treatment to get it in solution.

A Reader.—The McLeod] guage is described in the *Philosophical Magazine* for 1874, page 110. Mr. Gimingham's improvements in the Sprengel pump are described in *Proceedings of the Royal Society*, vol. xxv., p. 396.

P. Casamajor.—Received with thanks.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 905.

ESTIMATION OF PHOSPHORIC ACID IN PRESENCE OF SILICIC ACID.

By R. W. ATKINSON.

In the July number of the *Journal of the Chemical Society*, ii., p. 115, 1877, there appeared a short abstract of a paper by E. H. Jenkins (*Journ. Prak. Chem.* [2], xiii., 237—239) which stated that the presence of silicic acid does not interfere with the determination of phosphoric acid by means of ammonic nitro-molybdate, and that it is therefore unnecessary to remove it. As this seemed contrary to all experience, and thinking that it ought to be confirmed or corrected, I requested two of my students to make some estimations of phosphoric acid by this process in presence of different weights of silicic acid, and also in its absence. The following are the results:—

25 c.c. of a solution of sodic phosphate containing 0·025 grm. P_2O_5 were employed in each experiment. Ammonic nitro-molybdate was added, the liquid allowed to stand for eighteen hours, the precipitate washed, dissolved in ammonia, filtered, magnesia mixture added to the filtrate, and the precipitate weighed as magnesic pyro-phosphate. The silicic acid was in the form of sodic silicate.

First Series, by Mr. Watanabe.

	$Mg_2P_2O_7$.		P_2O_5.
1. No silica	0·0390 grm.	=	0·0249 grm.
2. No silica	0·0395 ,,	=	0·0253 ,,
3. 0·3935 grm. SiO_2	0·0455 ,,	=	0·0291 ,,
4. 0·7870 ,,	0·0505 ,,	=	0·0323 ,,
5. 1·1805 ,,	0·0555 ,,	=	0·0355 ,,

Second Series, by Mr. Takamats.

1. No silica	0·0392 grm.	=	0·0251 ,,
2. 0·223 grm. SiO_2	0·0409 ,,	=	0·0262 ,,
3. 0·553 ,,	0·0429 ,,	=	0·0274 ,,
4. 1·106 ,,	0·0451 ,,	=	0·0288 ,,

In both series it will be observed that the weight of the magnesic pyro-phosphate increases with the amount of silicic acid present, and therefore the apparent amount of phosphoric acid increases likewise. Although there is not a perfect agreement between the two sets of experiments as to the increase in weight of the magnesian precipitate for a given weight of silicic acid present in the solution, still, I think, it is sufficient to show that the silica ought to be completely removed before estimating the phosphoric acid. I trust you will oblige me by giving publicity to this correction.

University of Tokio, Japan,
February 7, 1877.

ON THE DIFFERENCE IN QUALITY OF SOME SAMPLES OF SO-CALLED PURE SODIUM ACID SULPHITE.

By W. F. K. STOCK, F.C.S.

Some time ago I received a supply of sodium acid sulphite, which was labelled "Pure for Analysis," and in using it for the reduction of acid solutions of ferric salts in the separation of phosphoric acid, I found that after neutralising with sodium carbonate the reduced solution, the addition of sodium acetate produced a precipitate which, though light red at first, became deeper and deeper upon boiling, until it had acquired a dirty olive-grey tint. This led to a suspicion of the presence of sulphur compounds of lower oxidation in the acid sulphite, and the salt was examined and found to contain hyposulphite.

In order to ascertain whether the occurrence of this impurity was the result of accident, I lately procured from six of the best known laboratory furnishers a small quantity of their pure acid sodium sulphite, as sold for the reduction of ferric salts in the "volumetric estimation of iron." Upon the arrival of the samples, they differed considerably in appearance, and ranged in colour from pale straw to white. The percentage quantity of matter insoluble in water was very small in each case, ranging from 0·14 to 0·06. When tested for hyposulphite only one sample was found to be free; it was from Messrs. Townson and Mercer. For the others, no two specimens were alike in the quantity contained; there was, moreover, a very wide difference between the potential of reduction of the best sample and the worst. When tried upon solutions of ferric chloride of known strength under exactly similar conditions, 40 parts of the best sample were equal in power to 100 of the worst. Now it seems to me that when a certain salt is sold as *pure* and fit for analytical work, some effort ought to be made by the firm selling the substance to ensure its being as near as possible the article it professes to be; because often in an active laboratory there is little time to spare for more than the application of a few simple tests to ascertain the comparative purity of reagents, and very considerable reliance is often—too often in fact—placed upon the name and fame of the firm supplying the material, and again it is especially necessary that the chemical reagents supplied to those who are struggling with the difficulties of a chemical education should really be pure in nature as well as in name. Imagine the embarrassment of a student on finding a coloured precipitate formed in a solution of say copper, arsenic, and ferric iron by the use of "pure" sodium acid sulphite, which he had added for the sole purpose, and with the one expected result of simply lowering the condition of the arsenic and iron previous to passing H_2S. It is difficult to conceive how the variation here dealt with occurs, for the methods of preparation of the "bisulphite" seem to be held within very narrow limits; it is a question, however, which deserves an answer, and I hope shortly to be able to communicate further with you upon this subject. Meanwhile I must apologise for the meagre character of this note, and claim indulgence for it solely upon the ground that there is good in everything which tends to equalise the conditions under which similar work is performed by different analysts.

A DEFENCE OF TURNER'S METHOD OF DETECTING BORACIC ACID.*

By C. LE NEVE FOSTER, B.A., D.SC., F.G.S.

A defence of Turner's method† seems at first sight to be quite unnecessary, for his test has been used over and over again, for upwards of fifty years, and, as far as I am aware, its usefulness has never been questioned till quite lately. Great was my surprise a few days ago to read a a paragraph "On the uselessness of Turner's flux as applied to the Detection of Boracic Acid."‡ Professor Chapman speaking of Turner's method, says:—"This test is much quoted in blowpipe books, and works on chemical analysis generally; but it is altogether superfluous. With borate of soda it fails entirely, or yields very unsatisfactory results; and although it answers for

* A paper read before the Mineralogical Society, December 18th, 1876.

† It consists in heating on Pt wire before the blowpipe the powdered mineral mixed with a flux made of 4½ parts of bisulphate of potash, and one part of finely powdered fluor spar. If boric acid is present the flame is coloured green.

‡ On some Blowpipe-Reactions, by Prof. E. J. Chapman. *Canadian Journal*, October, 1876.

most other borates, and for borosilicates, it is uselessly applied to them, because these bodies colour the flame equally well *per se*." He quotes from Buzengeiger (*Annales des Mines*, 1829, tome v., p. 36), in support of these statements.

Surely, I said to myself on reading the article, the careful Plattner and my good friend and most painstaking teacher, Prof. Theodor Richter, would never have recommended Turner's method if they had not been convinced of its value. Besides, I have so often used the test myself with such marked results that I feel quite satisfied that it is a useful one.

However, to fortify my conviction, and make quite sure that I have not been labouring under an optical delusion for the last seventeen years, I have lately made a series of tests, and I am glad to say that the reliance I have always placed on Turner's test does not appear to be unfounded.

My first experiments were made with a view to combat Prof. Chapman's assertion that "with borate of soda it (Turner's test) fails entirely, or yields very unsatisfactory results."

I suppose in speaking of "borate of soda," he refers to borax, and not to the neutral borate.

I first prepared some mixtures of borax and orthoclase, and then another series of borax and common salt. Some of the experiments were as follows:—

1. Borax mixed with three times its volume of Turner's flux, heated on Pt wire in flame of Bunsen burner, imparts a very decided green colour to the flame.

2. Mixture of ninety-seven parts by weight of orthoclase and three parts of borax, treated with flux in the same way. Distinct green coloration.

3. Mixture of equal parts by weight of borax and common salt, treated with flux in the same way. Decided green flame.

4. Mixture of nine parts by weight of common salt and one part of borax, treated as before. Flame plainly coloured green.

5. Mixture of ninety-eight parts by weight of common salt and two parts of borax, treated as before. By holding the Pt wire close to the flame of the Bunsen burner, without quite touching it, I managed to tinge the edge of the flame a distinct green.

6. Mixture of ninety-nine parts by weight of common salt and one part of borax, treated as before. By very carefully approaching the assay to the flame, I obtained a decided green coloration.

As is well-known, the green coloration does not last long, but it is very plain and characteristic.

The facts which I have just brought forward are surely sufficient proof of the delicacy of Turner's test, even in the presence of large quantities of sodium. In mixture No. 6 I only had 1 per cent. of borax, or about ½ per cent. of boric acid (B_2O_3), and yet I succeeded in obtaining a distinct reaction.

In all the above experiments I used a Bunsen burner, but as Prof. Chapman speaks of testing with the blowpipe flame, I tried several of my mixtures in that manner.

With No. 6 I failed to obtain a satisfactory coloration, but Nos. 4 and 5 gave a decided green. I need hardly say that to prevent any possibility of error on my part, I tested my Turner's flux alone and mixed with salt, and in neither case did I see any green tinge. Before using a piece of Pt wire, I invariably tried it in the Bunsen flame alone, and with Turner's flux, so as to make sure of its being perfectly clean.

Prof. Chapman's second assertion, that most of the borates (save sodic borate) and boro-silicates colour the flame equally well *per se*, as when mixed with Turner's flux, does not at all agree with the results that I have obtained on various occasions.

I made some comparative tests as follows:—I pulverised some schorl and made part of the powder into a paste with water, and mixed the rest with Turner's flux. I then tested the two on Pt wires simultaneously, at the opposite sides of the flame of the same Bunsen burner. The schorl alone gave at most a greenish yellow coloration, whilst when mixed with the flux, the green tinge, though evanescent, was very vivid.

Axinite treated *per se* before the blowpipe, in a darkened room, gives, it is true, a yellowish green colour to the flame, but the colour obtained by the use of Turner's flux is *to my eyes* far greener and more intense.

Axinite *per se* in the flame of the Bunsen burner does not give such decided results as in the blowpipe flame, but with Turner's flux I had not the slightest difficulty in securing a marked green coloration.

Such being the results of my experiments, I am almost at a loss to account for Prof. Chapman's statements. Two solutions of the difficulty may be suggested.

1. Prof. Chapman does not apply the test in exactly the same manner as I do. Having carefully prepared Turner's flux in accordance with Plattner's directions,* I invariably thoroughly incorporated 3 volumes of the flux with 1 volume of the finely pulverised mineral by *grinding the two together* in an agate mortar. I sometimes make the mixture into paste with water, and plaster it on to the loop of the Pt wire, or else heat the Pt wire, and dip it into mixture. On holding the assay at the tip of the blue flame before the blowpipe, or in the flame of the spirit lamp, or Bunsen burner, a vivid green colour appears, if boric acid is present, but, as said before, the coloration lasts but a short time.

2. It is possible that the colour afforded by fluo-boric acid does not produce the same effect on the eyes of Prof. Chapman as it does upon those of most people. Berzelius himself was well aware of the fact that two persons do not always apply the same name to a certain colour. "For instance," he says, "Gahn would call a tint yellow or dark yellow which I should have called red, although we both agreed in the case of the pure primary colour, whether yellow or red."† This will, perhaps, explain to Prof. Chapman why Berzelius says nothing about the coloration afforded by certain minerals when treated before the blowpipe. It does not follow that he "overlooked the coloration of the flame," but knowing that some of his observations differed from those of his master, Gahn, he may have thought it better to omit the impressions produced on his eyes by certain flames, fearing that they would not agree with those produced on other people.

Of course, I do not for a moment impugn the accuracy of Prof. Chapman's results as far as he is individually concerned, but I still think that by the majority of blowpipe workers, or "pyrologists," as my friend Major Ross dubs us, Turner's test will be found to be eminently satisfactory.

A NEW METHOD OF DETERMINING WITH ACCURACY THE MELTING-POINTS OF METALS AND OF OTHER SUBSTANCES BAD CONDUOTORS OF HEAT.‡

By Dr. HIMLY.

A KNOWLEDGE of the boiling points of liquids under the same atmospheric pressure has the same high value as a means of distinguishing them from each other as crystalline form has in the case of solid bodies. These constitute distinguishing physical characteristics in both cases; indeed, in cases of liquids, their purity is determined by the constancy of the boiling-point, of course excepting those liquids which are decomposed in the act of evapo-

* Plattner's "Probirkunst mit dem Löthrohre," 4te Auflage, 1865, p. 466.

† Translated from Berzelius's *Anwendung des Lothrohrs*, Nürnberg, 1821, p. 79.

‡ Translated from *Poggendorff's Annalen* (Feb., 1877), by a Member of the Physical Society.

ration. As regards the temperature of the boiling-point, certain physical conditions have been discovered as dependent on this, especially in the case of substances belonging to organic chemistry. How is it, however, as regards the temperuture of the melting-point. Here we must admit that the connection between the temperature of the melting-point and the physical constitution of the body is still wholly unknown to us. The importance of a knowledge of the melting-points is evident, if we only take into consideration the number of organic bodies whose melting-points are constant (when pure). How little we know of the connection between the molecular constitution of the body and its melting-point, may be illustrated by merely referring to the elementary substances. Why, for example, do platinum and iridium only melt at the highest temperature of the oxyhydrogen flame, while mercury is already liquid at 39° C. below the freezing point?

The melting-points of other metals lie between these extremes, but the varying densities of the metals give us no insight into this. To follow this inquiry further would lead too far from our present purpose. I will only put one more question:—What physical condition determines the fact that the metal calcium melts already at a red heat, while when united to oxygen (a gas so volatile as to be incapable of liquefaction), it is as infusible as carbon.

The number of melting-points reliably determined, whether in the case of simple or compound bodies, is (in proportion to the vast number of bodies) extremely small, and yet it will be only possible to deduce laws regarding the physical conditions which determine the melting-points, after a large number of these melting-points have been accurately observed. Under these circumstances, I think therefore I am doing a service to science if I make known a method for determining the melting-points which is easily applied and affects a remarkable accuracy, and is applicable equally to good and bad conductors of heat, such as metals, fats, &c.

In *Dingler's Polyt. Journal* (vol. 201, p.250), a very interesting method of determining the melting-points of organic substances which are non-conductors of electricity is described by J. Löwe. This method consists in coating a platinum wire with a layer of the substance whose melting-point is to be determined. The platinum wire dips into a bath of mercury, which latter is connected with an electric bell, a galvanic cell being placed in the circuit. So long as the coating of substance on the platinum wire remains unmelted the bell remains silent. The bath of mercury is gradually heated, the coating of substance melts, and the wire makes contact with mercury, and thus closes the electric circuit. The bell rings, and at that instant the temperature is read off by a thermometer placed in the bath of mercury. The difficulty of determining with accuracy the melting-points of substances which are bad conductors of heat, such as fats, &c. (especially when they possess a considerable latent heat) is well known, as also the imperfection of the method hitherto employed for this purpose, which consisted in placing the substances to be examined in capillary tubes, and in observing an approximated thermometer as soon as the melting began. On account of this difficulty, the ingenious method devised by M. Löwe was all the more to be welcomed. It is to be regretted, however, that the experiments made by a former scholar of mine, C. H. Wolff (and described in the *Archiv. d. Pharmacie*, vol. 3, 1875) have shown that the degree of accuracy expected was not attained, as, for example, in the case of a piece of white wax, M. Wolff obtained, in a series of twenty-four experiments results varying between 61·2° C. and 65·4° C., or a difference of 4·2° C. This circumstance caused him to diminish the thickness of the platinum wire, and to alter its form, by which means he says that, after many experiments, he reduced the difference to only 0·5° C. That with this method absolute accuracy was unattainable is no doubt to be ascribed to the difference in the conducting power for heat possessed by the platinum of the wire and the mercury of the thermometer.

Induced by the fact that the Royal Dockyard of Wilhelmshaven, besides requiring exact quantitative analysis of different white metals (of which, remarkably enough, two specimens contained about 5 per cent. of mercury), also required exact determinations of the melting-points of the same, I have for this purpose employed a method which has only that in common with M. Löwe, in possessing the arrangement of an electric bell. The object to be attained was not only to avoid the errors above alluded to in the determination of the melting-points of bad conductors of electricity and heat, but also to render the method applicable to the determination of the melting-points of substances which are good conductors of electricity and heat. This new method is as follows:—

The glass mercurial thermometers employed are made with thin ogival-shaped bulbs, and the bulbs (and also part of the tube) are chemically coated with silver. As the silver coating is very easily damaged, it is well to strengthen it with a coating of copper in the ordinary way by means of a weak galvanic current and a solution of sulphate of copper. Before this, however, a fine annealed copper wire is to be wound round the thermometer tube a little above the bulb. The wire is then to be laid along the side of the thermometer tube and fastened to it by an india-rubber band, to avoid all jerks on the wire, as the latter is afterwards to be connected with a galvanic cell. The coating of copper is allowed to extend above the point where the wire is attached, by which means a better metallic contact is ensured. For the determination of the melting-points of metals, or alloys and good conductors of electricity, the copper coating may be somewhat thicker for the sake of durability, while in the case of investigations with non-conductors, the copper coating should be thin, or may be dispensed with altogether. It remains now to describe the special method of procedure.

Determination of the Melting-Points of Metals and Good Conductors.—For this purpose a U-shaped tube with arms about 10 centimetres long is required, the glass of which, for the sake of durability, should not be too thin. The arms should be parallel and close to each other. The bore of the tube should not be much larger than the bulb of the thermometer employed.

The metal or alloy to be experimented upon is to be cast in the form of small bars, about the same thickness as the bulb of the thermometer. Besides this, an iron bowl or crucible is wanted, which can be slowly heated by means of a spirit-lamp or gas burner. According to the height of the melting-point to be determined, the crucible is to be filled with mercury or some fusible alloy. To carry out the experiment, the thermometer with its attached wire is to be placed in one arm of the U-tube, and the small bar of metal to be tested in the other. The bar should be pushed in quite up to the bend, so that the bar and the bulb of the thermometer are as near together as possible without touching. A conducting wire reaching down to the bend of the tube is placed by the side of the metal bar, the wire being of such a length as to admit of being conveniently connected with a galvanic element. The whole arrangement with the U-tube is attached to a convenient support with clamp, so that the U-tube can be immersed in the bath of mercury or melted alloy.

An electric bell (with galvanic element) is inserted in the circuit between the two wires attached to the thermometer bulb and metal bar respectively. The complete circuit is therefore only broken at the bend of the U-tube, and as long as this interruption lasts, the bell is silent When, however, the heating of the metallic bath in which the U-tube is immersed has gone so far that the metal bar in the tube melts, then the melted metal closes the electric circuit. At the same instant the bell rings, and the reading of the thermometer is taken. When it is considered that the thermometer and the metal bar are

exposed under perfectly similar conditions to the source of heat, the accuracy of the melting-point thus determined must be self-evident. This method of experimenting is of course only to substances which are conductors of electricity, and whose melting-points are such as to permit the use of a mercurial thermometer. This principle would also be applicable to metals with high melting-points, provided the U-tube were made of some refractory material, and a suitable pyrometer substituted for the thermometer.

Determination of the Melting-Points of Substances, Non-conductors of Electricity and Heat.—For this investigation also the metallically-coated thermometer with conducting wire attached, is employed. The substances to be examined are first melted, and just when solidification begins again to set in at the sides of the containing vessel, the metallically-coated bulb of the thermometer is dipped for an instant into the substance. In this way the bulb of the thermometer is coated with the substance to be examined. It suffices if the coating be from one to two millimetres thick. Further, an iron crucible is required with a hole formed in the lid. In this hole a thin porcelain crucible filled with mercury is placed, which dips well into the liquid in the iron crucible. The liquid in the iron crucible may consist of glycerin, or a solution of chloride of calcium in glycerin, which may be heated to a temperature of 200° C. without giving any trouble. If higher temperatures are required, then it would be well to use a bath of liquid alloy or mercury.

The carrying out of the experiment is very simple. After the bulb of the thermometer (and a small part of its tube) has been coated in the manner described with the substance to be examined, and the whole has become cool again, then the thermometer is immersed in the mercury of the porcelain crucible. The wire attached to the silvered coating of the thermometer, and a wire dipping in the mercury are then respectively to be connected to the circuit containing the galvanic element and bell. Then the glycerin bath is to be slowly heated.

Since now the substance whose melting-point is to be determined is in actual contact with the bulb of the thermometer itself, it is clear that at the instant of melting (when the bell rings), the thermometer must give the temperature with wonderful accuracy. This is in itself so evident that it is not necessary to refer for illustration to the number of experiments which have been made.

It may just be added in conclusion that in measuring the melting-points of metals or alloys, the level of the metal bar to be tested should be completely below the level of the melted substance in the heating bath, and the bath should be heated uniformly, *i.e.*, not only underneath, but at the sides. The uniform heating of the bath may be best attained by stirring its contents with a small iron bar; also it is well to take care that the U-tube is not irregularly bent, so that there is no unevenness in the bend of the tube to obstruct the free downward flow of the metal from the melted bar.

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

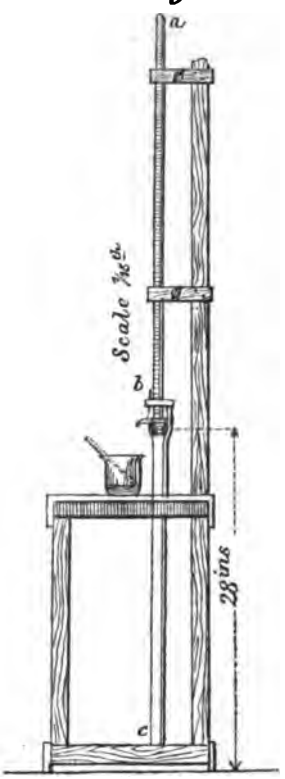
Second Paper.—On a New Mounted Burette.

By P. CASAMAJOR.

At the last meeting of this Society I described and exhibited a new burette of the portable class. This evening I will solicit your attention to another new burette of the class called mounted or permanent.

Burettes of this class have many advantages over portable instruments. For one thing they can be made much longer, so that, for the same degree of minuteness in their scales, they are able to hold much larger quantities of liquid, and consequently do not require to be replenished so often. They are also less liable to breakage than portable instruments, as they are firmly held in a stand and are not so subject to accidents from handling. Instruments of this class have, however, a serious defect in common, which is that they have an opening at the bottom, from which the test solutions run out, the flow being regulated by a valve or cock, which generally lets the contents leak out at wrong times. Even when the key of a glass cock fits perfectly, if it is sufficiently loosened to allow it to work with nicety, enough liquid may escape around the key and remain adhering to the instrument to afford inaccurate results.

Fig. 1.



Dr. Mohr's burette is not open to this objection, but it is ill adapted to hold many of the solutions used in volumetric analysis on account of the perishable nature of its rubber tube.

After trying for a long time to contrive a valve or cock not liable to leakage I turned my attention in another direction, and the result is the combination I present to you this evening, which shows a mounted burette without a valve or a cock (see Fig. 1 and Fig. 2).

This result has been accomplished by dividing the burette into two portions; one, which I will call the outer tube, holds the test solution, while the other, which is the inner tube or plunger, bears the graduated scale. As this latter portion sinks into the outer tube it displaces a certain volume of liquid, which finds its way out through the little beak c (Fig. 3).

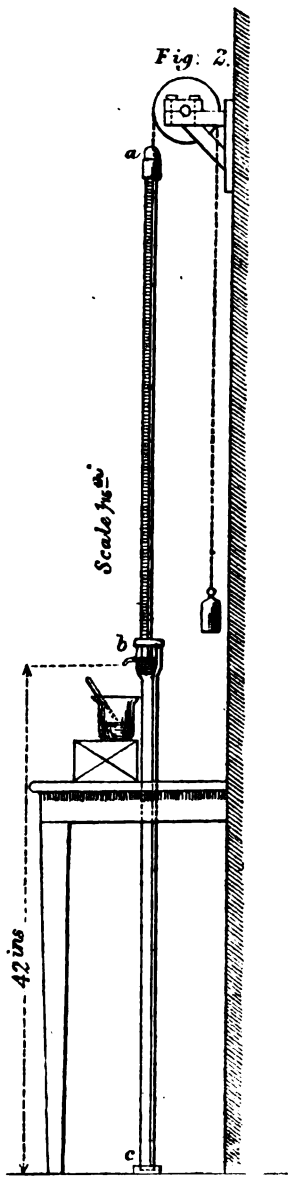
The plunger tube, being a plain cylinder, has nothing in its shape that deserves attention. It is not so, how-

* Read before the American Chemical Society, December 7, 1876.

Note.—Since reading this paper before the American Chemical Society, I have found that in the essential characteristics of this burette I had been anticipated. In the new work by E. J. Maumené, *Traité Théorique et Pratique de la Fabrication du Sucre*, vol. i., p. 482, is a woodcut, accompanied by a description, of a burette, in which the liquid is displaced by a plunger, and it drops out from a small beak at the top of the outer tube. The burette is attributed to E. J. Maumené, the preface of whose book bears the date: Paris, Septembre, 1876.—P. C.

ever, with the outer tube, whose upper portion is expanded and provided with a beak. This portion is represented in Fig. 3, in which A is the outer tube, B the plunger, C the beak, belonging to the outer tube, and D the index. In this figure I have endeavoured to give every detail that is necessary to obtain single drops when the plunger is properly lowered. The object of enlarging the upper portion of the outer tube is to prevent any variation in the surface of the liquid. If the outer tube was not made larger at this part the plunger tube, as it

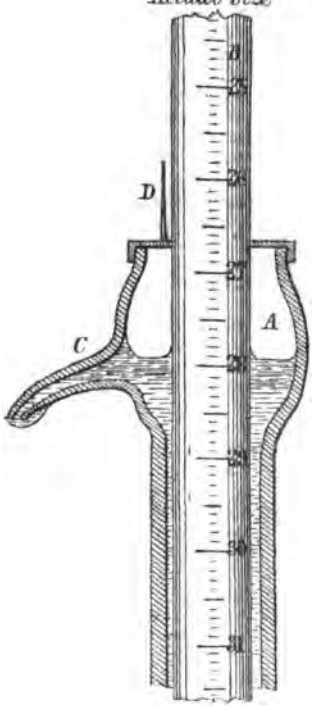
Fig. 2.



moved down, would not keep equally distant from every portion of the inner surface of the outer tube. Whenever the distances varied the shape of the surface of liquid would vary also, rising as the sides of the tubes drew nearer together. The consequence of this would be that for a downward movement of the plunger, sufficient to afford a drop, sometimes no liquid would fall, and at other times, several drops would fall in succession. By widening the upper portion of the outer tube, the surface of the liquid remains the same for all positions of the plunger.

The shape taken by the liquid at the top of the outer tube is represented in Fig. 3. We may notice that the surface of the liquid, between the plunger and the outer tube, forms a ring, the liquid rising slightly as it touches the glass surfaces. At the end of the beak there always remains a small particle of liquid, which ought to spread partly on the under surface of the beak, as shown in Fig. 3. The liquid with an annular surface between the two tubes, that which fills the beak, and the small portion adhering to the end of the beak, form altogether a system whose equilibrium is very easily disturbed. When the inner tube is pushed down sufficiently, so that the additional volume that enters in the liquid is equal to about $\frac{1}{10}$ of a cubic centimetre, the small volume of liquid at the end of the beak increases perceptibly and a drop escapes. Unless the beak is so small as to remain entirely full of liquid

Fig. 3.
Actual Size



and unless the end of the beak is such that a small volume of liquid adheres to it exteriorly, delicacy of equilibrium cannot be obtained, and the burette will not respond with readiness and regularity to very small downward motions of the plunger.

As glass tubes are not made cylindrical but slightly conical, an accurate graduation could not be obtained by taking the whole volume of a tube between two points, situated near its extremities, and dividing the space equally into cubic centimetres. The best plan is to divide a long tube into several equal portions, each representing a known number of cubic centimetres, and afterwards sub-divide each portion into centimetres and fractional parts. The plunger of this burette was divided into portions of 10 c.c., and each such portion was subdivided into centimetres and tenths. To effect this the first step was to take a long and narrow test-tube, which was gauged by placing in it 10 c.c. of water, and marking the surface of the liquid on the side of the tube. This tube, after being emptied and dried with bibulous paper

was ready for use. The outer tube of the burette, being filled with water so that a portion drops out of the beak, the plunger, with its bottom closed but its top still open, is lowered gradually until a few drops have started again from the beak. This is the starting point which is marked on the plunger opposite to index, which may very conveniently be placed on a cap covering the outer tube (see D, Fig 3). The mark on the tube may be made with a file, previously moistened with spirits of turpentine or petroleum, to prevent the abrasion from cracking the glass. In the next place the test-tube, capable of holding 10 c.c. is placed under the beak, and the plunger is lowered until the test-tube is filled up to the mark designating 10 c.c. Another mark is then made on the plunger tube as before, and the operation is repeated until the bottom of the plunger touches the bottom of the outer tube. After every volume of 10 c.c. has been measured, the test-tube is dried with bibulous paper to get it ready for the next measure. When the operation is ended, the result is a series of marks on the plunger, between which its outside dimensions are equal to 10 c.c. Now a long and narrow strip of paper is taken, and the distances between the marks on the plunger are transferred with a compass on the paper. After this each space is divided into 10 equal parts, which are again sub-divided into 10 equal parts, the smaller divisions representing tenths of cubic centimetres.

The next step is to introduce the paper scale into the plunger tube, which was found to be a difficult operation, as the strip of paper would not go in straight on account of its great length. The difficulty was overcome by pasting the strip of paper to the outside of a glass tube, whose diameter was small enough to allow it to slip easily into the plunger tube. A little wad of paper or cotton should be placed in the plunger tube before introducing the tube bearing the scale, to prevent a sudden shock from cracking the tubes.

The scale should be placed on the narrower tube in such a way that, when lowered in its place, the divisions of the paper scale corresponding to 0, 10 c.c., 20 c.c., &c., may be found opposite to the file marks on the plunger tube. Afterwards the top of the plunger tube is closed by melting over a lamp.

In Fig. 1 and Fig. 2 are shown two manners of mounting the burette. In Fig. 1 the height from the beak to the bottom of the outer tube is 28 inches, and the instrument may be placed either on the floor or on a table. In the first, the operator must be seated, while, in the second case, he must stand, so that in every case his eye may be placed opposite to the index. The plunger tube, in Fig. 1 is held by two clamps.

In Fig. 2 the distance between the beak and the bottom of the outer tube is 42 inches. The outer tube reaches to the floor, and it may be protected by a case of wood or metal. The plunger is attached to a flexible band or belt, free from torsion, so that the scale will always remain in front of the index. The belt passes over a pulley attached to the wall of the laboratory, and the other end of the belt bears a weight to counterbalance the plunger tube. The operator must be seated when using this instrument. A burette of greater length may be made on the same plan by running the outer tube to the floor, and making it high enough to place the index opposite to the eye of the operator when standing.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

March 17th, 1877.

Professor G. C. Foster, F.R.S., President, in the Chair.

Mr. W. S. Seaton was elected a member of the Society.

Mr. Spottiswoode exhibited some experiments on the stratification of the electric discharge in vacuum tubes, and described his attempts to produce the effects as obtained by Mr. Gassiot and Mr. De la Rue, with batteries of several thousand cells by means of the induction coil. He showed the different forms of striæ produced in several different gases, and mentioned that the side towards the negative is always sharply defined, and that towards the positive gradually shades off into darkness. Mr. Spottiswoode has examined them by means of a rotating mirror, the mercury break being worked by the axis of the mirror so that the one only varies with the other. It was thus clearly ascertainable whether a band was progressing towards either pole or remaining stationary, or was intermittent, according as the line observed in the mirror was inclined or horizontal or broken. He considers that the ordinary break prolongs the sparks, so as, in some cases, to give rise to the ill-defined nature of the striæ, and he showed two forms of contact breaker adapted to these experiments. In the first the breaking was effected by a steel rod caused to vibrate by an electro-magnet, the number of these vibrations being determined by the musical note produced. In the apparatus now usually employed, however, a brass wheel is caused to rotate with great rapidity, the tops of the teeth are covered with platinum, the spaces between them being filled in with ebony. It was shown that if the current be made and broken by a wire resting on the rim of this wheel, the bands may be caused to move in one direction or the other, or remain stationary according to the velocity of rotation of the wheel. A very ingenious arrangement, invented by Mr. Spottiswoode's assistant, Mr. Ward, was employed for introducing resistance into the secondary circuit, and thereby adjusting the strength of the current to suit the velocity of rotation of the wheel. It consisted of a spiral column of mercury surmounted by a vessel containing a badly conducting liquid, and by raising or lowering a cup connected with the base by means of an india-rubber tube, the amount of mercury present in the column is increased or decreased, the resistance offered by the column of constant length of course varying in the inverse proportion.

Capt. Abney, R.E., then read a paper on the photographic image, prefacing it by a brief account of the two theories, the chemical and the physical, which are held regarding it. On the former a molecule of bromide of silver is split up into sub-bromide and bromine, the latter of which is absorbed; and, on the latter theory, light acts mechanically on the molecule shifting the positions of the atoms. Poitevin has done much to confirm the former of these by placing a film of silver iodide in contact with a silver plate, when he succeeded in obtaining an image both on the film of iodide and on the silver plate, produced by the liberated iodine. Capt. Abney has performed the following experiment:—A portion of a dry plate, which had been exposed was wet with a sensitive collodion emulsion of bromide of silver and developed by the alkaline method; the films were separated from the glass and from each other by means of gelatinised paper, and were found to bear images; and the same result was obtained when the emulsion was added after exposure, development, and fixing. These experiments entirely disprove the supposition that only those molecules acted on by light are reduced. If the two films be separated by a thick layer of albumen, the lower picture develops as a negative and the upper as a positive. Capt. Abney is now engaged in an attempt to determine the attraction exercised by the sub-bromide, and this, it is hoped, will do much towards the complete solution of the problem of the photographic image.

Mr. O. J. Lodge proposed a modification of Mance's method for determining the intensity of an electric current. This method, of which Wheatstone's bridge is an application, depends upon the fact that if three conductors be united at a point A, and their extremities B C and D be united by three wires B C, C D, D B, the resistance of B C will be independent of that of A D if A B is to A C as B D is to C D. In the arrangement proposed by Mr. Lodge four wires are joined in the form of a square, and

the circuit can be completed across one diagonal by means of a key, and in the other diagonal is included a condenser and a galvanometer with a long fine wire. The greatest sensitiveness is obtained when the resistances in the four sides are equal. A great advantage of this method consists in the fact that it is equally applicable to the measurement of small and great resistances. Mr. Lodge then showed a modified form of Daniell's cell, capable of giving a constant current for a considerable period. A glass cell, half filled with dilute sulphuric acid, contains two vertical glass tubes, one of which, open at both ends, is traversed by a zinc rod, while the other is closed at its lower end, and contains cupric sulphate, from which rises a copper wire. The portion of the copper tube projecting above the acid is sufficiently moist to enable the current to traverse its surface, while the zinc sulphate is prevented from reacting on the copper.

NOTICES OF BOOKS.

Directions for the Use of the Aniline Colours in Dyeing Leather. By M. W. EITNER, Director of the Imperial Laboratory.

THE author recommends, for leather-dyeing, the aniline colours prepared by the Berlin Aniline Dye and Colour Company, which are specially arranged to suit the requirements of this trade. The preparatory operations required present no novel features, it being merely requisite that the leather should be perfectly clean, those intended for light shades being of course washed for a much longer time than those destined to receive dark colours."

For the production of so-called "Russian red"—formerly obtained with the red woods, along with a solution of tin and the occasional addition of alum or of tartar—the "Juchtenrath" or "leather-red" is recommended. It is produced in three shades—G, light; G R, medium; and R, dark. The colour required is simply dissolved in 100 parts of clean, soft, boiling water, condensed steam-water being very suitable. The solution thus obtained is left to settle for two to three hours, and the clear liquid is then taken in greater or less quantity, according to the size of the pair of skins to be treated, diluted with warm water, and is then ready for use. It is not desirable to use a concentrated bath at the outset. The first pair of skins is therefore dipped at the beginning in a very dilute bath. They are then taken through a second and a third, each stronger than the foregoing. The second pair of skins is dipped in the second of the baths already used, then in the third, and lastly in a new bath as strong as the third before it had been used. Thus each bath is used three times, and each pair of skins is passed through two old baths and one new one. In this manner the colour is thoroughly used up, and an even shade is obtained on the skins, which, if entered at once in a strong dye-bath, would take the colour irregularly and become cloudy. When dyed, the skins are plunged in pure cold water, rinsed, placed on the stretcher, and slightly oiled. If birch-oil is used, for the sake of the peculiar odour of Russian leather which it imparts, care must be taken that no free acid is present, as always happens if the oil has been sophisticated with wood-tar; it must be carefully neutralised with carbonate of soda. The dyed leather should be rapidly dried in a room specially fitted up, as the aniline colours can endure higher temperatures than shades obtained from the woods. For moistening the leather for the subsequent finishing operations very dilute solutions of "G" may be used.

A fourth shade, GG, gives a yellower red. Another, "Red S," gives the cochineal shades, especially pink. In the use of this dye the bath must be made as hot as the leather can bear. An addition of saffron (? safflower, or saffranin) decoction, as in the treatment with cochineal dyes, enhances the brilliancy of the colour.

Most yellow dyes derived from coal-tar produce dark spots on such portions of the grain-side of the leather as have been scratched or scraped. Certain colours, however, prepared by the Berlin Company are free from this defect. Phosphine-orange gives the "brightest and most intensely yellow of the yellowish brown shades, commonly termed almond-yellow." It requires 500 parts of water for solution, and must be boiled till no residue remains. The liquid is then ready for use at once without dilution. If a less fiery shade is wanted, treatment with a solution of bichromate of potash lessens the vividness of the dye.

For a gold-orange colour the Philadelphia yellow of the same Company is recommended, dissolved in 300 parts of water.

A redder shade is produced by "Berlin brown G," which is well fitted for reddening the darker shades produced with the dye-woods.

A pure orange may be obtained with "corallin" dissolved in 150 parts of water. It must be dyed and afterwards dried as rapidly as possible, as it has a tendency to fade.

A "half-dark subdued blue" is produced with "marine blue" dissolved in 300 parts of water. The skins must *not* be previously passed through dilute sulphuric acid.

For a pure light blue "water-blue B B" is taken, and for redder shades "water-blue R."

Dark blues were formerly obtained by the use of a red dye-ware over a vatted ground. The result is better obtained by grounding in "water-blue R" and topping with "nigrosin" dissolved in 300 parts of boiling water. Nigrosin applied directly to leather dyes uneven shades.

"Methyl-green" is much used for topping skins which have been dyed green with extract of indigo and fustic. All sulphuric acid must first be carefully washed away.

"Methyl violet" can be successfully used even on the worst skins.

The "B" variety yields blue shades, and the "R" produces red shades. The colour is dissolved in boiling water, but may be used cold.

CORRESPONDENCE.

CORRECTION FOR WEIGHING IN A VACUUM.

To the Editor of the Chemical News.

SIR,—Being interested in the errors introduced into chemical analysis by weighings conducted at different atmospheric pressures, I was led to study the literature of the subject, and in doing so I came across what appears to me a curious mistake, or, at all events, a statement which, looked at from whatever point of view I may, I cannot understand. In the CHEMICAL NEWS (vol. xxix., p. 20) there is a short paper by Charles W. Folkard, entitled, "Limits of Accuracy Attainable in Ordinary Weighing," in which the author considers the difference in the weight of a platinum dish when weighed against brass weights on the first occasion with the bar. at 760 m.m., and on the second when the bar. has fallen 12·5 m.m. The considerations involved are stated as follows:—"So the bulk of air displaced by the weights is 10·7 c.c., one-third of this being compensated for by the volume displaced by the platinum; consequently the remaining two-thirds only are to be considered:—10·7 c.c. × ⅔ = 7·13 c.c. . . . . Now, the 7·13 c.c, of air weigh 0·00922 grm. (at 760 m.m.), and by this diminution of pressure (12·5 m.m.) will weigh 0·00015 grm. less. Therefore, the weights being buoyed up by 0·00015 grm. less, the dish will apparently weigh 1½-tenths of a milligramme more than before." It is this last statement which creates the difficulty in my mind, for, if the weights at the second weighing are buoyed up by 0·00015 grm. less than at the first weighing the end of the beam to which they are attached will fall, and, in order to

bring about equilibrium, some of the weights will have to be removed; consequently the platinum dish will appear to weigh 0·00015 grm. *less* at the second weighing, and not more, as stated by Mr. Folkard.

I have the same difficulty in comprehending Mr. Crookes, in the paper read before the Royal Society—"Researches on the Atomic Weight of Thallium," contained in the same vol. of the CHEM. NEWS, p. 29.

I have thought it better to put the matter to the test of experiment, and as I cannot conveniently weigh at pressures varying considerably from one another, it appeared to me that I should be fulfilling the necessary conditions, if for the rarer atmosphere I employed air at the ordinary pressure, and for the dense atmosphere water. The results would of course be exaggerated, but that would be rather an advantage than otherwise. The scale pans of a balance having been removed, a piece of glass rod was attached by means of a hair to one end of the beam, and counterpoised with platinum wire similarly attached to the other end. Beakers of water were brought under the platinum wire and glass rod, and raised, so that these bodies were immersed. On unlocking the beam the end to which the platinum wire was attached was depressed, so that, in order to bring about equilibrium, some of the wire had to be removed; and I should express this result by saying, that the glass at the second weighing (in water) appeared lighter than at the first weighing (in air). This experiment was intended to be representative of the case considered by Mr. Crookes, and it appears to me to support my own view.

I am somewhat diffident in bringing this matter forward, as the probability of the two gentlemen mentioned making a mistake of this kind is rather small, and I can scarcely believe that they have done so, but as I have given the subject some little consideration, and being unable to comprehend it as stated, I feel justified in laying the matter before your readers in the hope that, if wrong, one of them will kindly set me right.—I am, &c.,

T. C. CLOUD, A.R.S.M.

Laboratory, Wallaroo Smelting Works, S. Australia,
January 20th, 1877.

[The subject is fully explained in Mr. Crookes's paper. The writer can also consult with advantage Prof. W. H. Miller's paper "On the Construction of the New Imperial Standard Pounds," in the *Phil. Trans.* for 1856, part 3.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 10, March 5, 1877.

Temperatures of Combustion.—M. Berthelot.—Not capable of useful abstraction.

Method of Extracting Platinum from the Chloroplatinates.—M. E. Duvillier.—The author for this purpose takes advantage of the property of the salts of platinum of being reduced by alkaline formiates at the boiling-point in presence of alkalies.

Physical and Mechanical Actions Exerted by the Incandescent and Strongly Compressed Gases from the Combustion of Gunpowder. Application of these Facts to Certain Characters of Meteorites.—M. Daubrée.—Gases strongly compressed act differently according as they are completely imprisoned or as they escape with great speed in a given direction. In this latter case their hot particles follow each other in a very brief part of time upon each part of the body which is exposed to their friction and their destructive action. They accumulate their heat upon it so as to produce fusion, and they carry off mechanically the metal as soon as melted in the state of an impalpable powder. In this condition the metal combines rapidly with sulphur.

Isomerism of the Rotatory Power in Camphols.—M. J. de Montgolfier.—The author finds that the rotatory power +37° of natural and of artificial borneol is absolutely identical.

An Aniline-Black Vat, and on the Conversion of Aniline-Black into a Fluorescent Rose Colouring Matter.—M. Goppelsrœder.—The base of electrolytic aniline-black dissolves in fuming sulphuric acid. The solution, if poured into water, forms a green precipitate, which, on washing with water, dissolves with a green colour. This solution dyes wool green, is turned blue by alkalies, and is rendered green again by acids. It is decolourised by the hydrosulphites, as also by zinc in presence of acids, and is again turned green by a few drops of fuming nitric acid. It is decolourised by sodium amalgam, and is turned by the hypochlorites first to a blue-violet, then to a red-violet, and becomes green again on contact with sulphurous acid. An excess of hypochlorite turns it a reddish yellow, which becomes yellow on the application of heat. Chlorine water renders it blue-violet, blue, violet, and lastly vinous red. With sulphate of copper it gives a green precipitate, which, if washed and suspended in water and decomposed by sulphuretted hydrogen, gives a nearly colourless filtrate, becoming green again on exposure to the air, and violet on the addition of chlorine water. The alkaline blue-violet solution of the green precipitate is turned green by an acid, and is subsequently rendered turbid by a green deposit. It becomes a red-violet on the addition of hypochlorites. If heated it is turned orange-red, and even yellow and red-violet by bromine and chlorine, an excess of which, however, decolourises it. Fuming nitric acid turns it green, and on the application of a gentle heat it is decolourised. The blue-violet solution is decolourised by reducing agents. If treated with glucose it becomes a brownish yellow, but is rendered blue again on exposure to the air, and violet-blue if treated with hypochlorites. It is reduced by Schützenberger's hydrosulphite of calcium, as well as by zinc and by the mixture of glycerin, stannite of soda, and soda proposed by M. Prud'homme for the reduction of indigo. Fibres steeped in these vats are coloured on exposure to the air violet, then violet-blue, and blue, shades which are rendered green by acids. The light blue is changed on superoxidation to a grey, and the deep blue to a black. The most varied shades may thus be produced from light grey to black. By saturating the tissue with the solution of the chromogen, this is changed in the air into a colour which remains fixed upon the fibre, and which, upon treatment with an oxidising agent such as the solution of ferric chloride acidulated according to the method of Jeanmaire, is changed to a grey or a black which does not turn green. The fibre may also be alternately steeped in the vat and exposed to the air to superoxidise it, and arrive at a black incapable of "greening." These operations are repeated till the wished-for shade is obtained. The black vat may be associated with the indigo vat, or it may also be used for printing. It will also serve for ink and for marking goods at dye and print works. The base of electrolytic aniline-black has been treated with melting bisulphate of potash; sulphurous acid and nitrogen escape. The fused mass contains neither sulphite, hyposulphite, nor sulphide, and imparts to water a yellow colouration. The residue insoluble in water was treated with hot concentrated sulphuric acid. The solution was poured into water, when an abundant black precipitate was produced. The liquid took a red-violet colour and became fluorescent on the addition of ammonia. The precipitate on treatment with alcohol gave a red colouring matter having the same fluorescence and the same characters, spectroscopic and chemical, as naphthaline-rose. It dyes silk. Along with the rose there is also formed a very small quantity of a violet colouring matter.

Researches on the Acidity of the Human Gastric Juice.—M. Ch. Richet.—The quantity of liquid in the stomach has no influence upon its acidity. Wine and alcohol augment the acidity, but sugar diminishes it. The gastric juice is more acid during digestion than at other times.

Action of Hydrosulphite of Soda on the Hematosin of the Blood.—M. P. Cazeneuve.—On causing hydrosulphite to react upon hematosin (Chevreul), called also hematin by German authors, the following results were obtained:—The hematosin was dissolved in boiled distilled water and rendered alkaline with ammonia, and the solution was then submitted to spectroscopic examination. The characteristic band of the alkaline solutions of hematosin was observed. But on adding one or two drops of hydrosulphite the dichroic tint of the alkaline solution disappeared, and was succeeded by a vermillion-red tint, which might be taken for the colour of a solution of oxyhemoglobin.

A "Fire-damp metre" which may Serve to Determine the Amount of Protocarbide of Hydrogen in a Mine.—M. J. Coquillion.—The author has contrived two forms of his apparatus, the one for use in the mine and the other for laboratory purposes. Both depend on the principles that hydrogen and its gaseous carbides are completely burnt in presence of oxygen and a palladium wire raised to white redness.

Chemical Examination of Turnerite.—M. F. Pisani.—The author finds in this mineral—

Phosphoric acid	28·4
Oxides of cerium and lanthanum.. ..	68·0
	96·4

Les Mondes, Revue Hebdomadaire des Sciences,
No. 5, February 1, 1877.

The Absorption-Radiometer.—M. Thoré.—If the luminous cone from a lens is thrown across a small glass tube, at the bottom of which is placed a pinch of charcoal dust which is gently shaken in order to distribute it in the ambient air, we see the cone defined by the reflection of the light from these particles, but on examining attentively with the aid of a lens magnifying eight or ten times the extremity of this cone, that is to say the place where all the luminous and calorific rays are united, we observe a very curious fact, that all the particles are animated with a very rapid movement of projection parallel to the axis of the cone.

Nos. 6, 7, and 8, February 8, 15, and 22, 1877.

These issues contain no chemical matter.

No. 9, March 1, 1877.

M. Zinno prepares oxygen on the large scale by causing permanganate of potassium to react on binoxide of barium diluted with water.

Carbuncle is traced by M. Koch to the introduction of bacteria into the system by stinging-flies. They obtain the poisonous germs from putrescent carcases.

An explosive has been introduced under the name of pantopollite. It consits of nitroglycerin dissolved in naphthalin. The fumes developed on its explosion are extremely distressing, producing violent pain in the head and chest.

No. 10, March 8, 1877.

M. Cance is said to have constructed an electro-magnet much superior to that of M. Camacho.

A composition for preventing incrustations in steam boilers composed of mashed potatoes, alum, and soda has been devised by MM. H. Beaucourt and Co. It bears the strange name of "Antitartaric Paste," and is recommended by the Abbé Moigno, who remarks: "It will be seen that I have not ceased to be the active centre of progress!"

In the notice of a work on the purification and utilisation of sewage the daring statement is made that in England irrigation has been found the only realisable process.

Cause of the Movement of the Radiometer.—MM. Bertin and Garbe.—These authors repeat the erroneous statement that the results obtained by Mr. Crookes disagreed with those of Dr. Schuster.

No. 11, March 15, 1877.

This issue contains no chemical matter, and is to a great extent taken up with a denunciation of the astronomer Flammarion, an attempt to connect the end of the Turkish Empire with the "Great Pyramid," and a re-investigation of the very inconvenient case of Galileo.

Reimann's Färber Zeitung,
No. 8, 1877.

This issue contains merely receipts.

No. 9, 1877.

Alleged Poisonous Colours.—The Berlin political papers have brought up a case of inflammation of the eyes produced by knitting with red woollen yarn dyed with "nitronaphtholin." Dr. Reimann points out that there is no such colour in existence, and that binitronaphthol, which may possibly be meant, is a yellow, not a red dye, and is never used in producing a red on wool.

No. 10, 1877.

A mordant for Turkey-red is said to have been discovered in France, and to be in use on a large scale.

M. Reimann denies the existence of magenta in red wines, since they invariably contain tannin, which would precipitate the magenta, or any other aniline colour.

No. 11, 1877.

This issue is to a great extent taken up with a controversy between the editor and certain unscientific papers on an alleged case of inflammation of the eyes said to be due to the use of knitting wools dyed with a poisonous colour. Dr. Reimann has decidedly the best of the argument.

MISCELLANEOUS.

Royal Institution of Great Britain.—Lecture arrangements after Easter, 1877:—

Prof. John Hall Gladstone, Ph.D., F.R.S. — Five Lectures on the Chemistry of the Heavenly Bodies; on Tuesdays, April 10 to May 15. Three lectures (lectures and subject undetermined); on Tuesdays, May 22, 29, and June 5.

Prof. Tyndall, D.C.L., L.L.D., F.R.S.—Eight Lectures on Heat; on Thursdays, April 12 to May 31.

Edward Dannreuther, Esq.—Two Lectures on Chopin and Liszt, with many illustrations on the pianoforte; on Saturday, April 14, and Thursday, June 7.

The Rev. Archibald H. Sayce, M.A., Fellow of Queen's College, Oxford.—Three Lectures on Babylonian Literature; on Saturdays, April 21, 28, and May 5.

Walter H. Pollock, Esq., M.A.—Three Lectures on Modern French Poetry; On Saturdays, May 12, 19, 26.

Charles T. Newton, Esq., C.B., Keeper of Greek and Roman Antiquities in the British Museum.—Two Lectures on the Recent Discoveries at Mycenæ; on Saturdays, June 2, 9.

The following are the probable arrangements for the Friday Evening Meetings after Easter, 1877, to which members and their friends only are admitted:—Friday, April 13, William Spottiswoode, Esq. LL.D., Tr. R.S., Sec. R.I., "Experiments with a Great Induction Coil." Friday, April 20, Frederick Pollock, Esq., M.A., "Spinoza." Friday, April 27, Lieut.-Gen. Richard

Strachey, R.E., F.R.S., "The Physical Causes of Indian Famines." Friday, May 4, Rev. W. H. Dallinger, "Researches on the Origin and Development of Minute and Low Forms of Life." Friday, May 11, D. Mackenzie Wallace, Esq., M.A., "The Intellectual Movements and Secret Societies in Russia." Friday, May 18. Friday, May 25, G. J. Romanes, Esq., "The Evolution of Nerves and Nervo-Systems." Friday, June 1, Oscar Browning, Esq., "The History of Education." Friday, June 8, Prof. Tyndall, D.C.L., LL.D., F.R.S.

The Chemical Society's Dinner.—The President, Fellows, and friends of the Chemical Society dined together on the 20th inst. at Willis's Rooms. About 200 were present. After the national toasts had been duly honoured, Professor A. W. Williamson proposed "The Learned Societies," which was responded to by Professor Huxley and Mr. Bramwell, C.E. Professor Odling then proposed "Success to the Chemical Society," which was responded to by the President, Professor Abel.

Fownes's Manual of Chemistry.—Messrs. J. and A. Churchill are issuing a new edition of Fownes's Manual of Chemistry. The rapid development of the science of chemistry having caused a steady increase in the bulk of this work, it has been determined to divide it into two volumes, each complete in itself. The first volume, which is already published, will henceforth be known as "Fownes's Physical and Inorganic Chemistry," the second as "Fownes's Organic Chemistry." The work continues to be under the able editorship of Mr. Henry Watts, F.R.S.

Yorkshire College of Science.—Purchase of Site for Permanent Buildings.—One of the most important steps yet taken by the governing body of this college was decided upon at the last meeting of the council, when it was unanimously resolved to purchase from Mr. John Lawson the Beech Grove Hall estate, containing about 3½ acres of land, at the price of £13,000, as the site of the permanent buildings. Since the meeting, we understand the contract of purchase has been signed. The total donations to the college have now reached the sum of £42,456. The site which has been secured is within a mile of the railway stations, and in proximity to Woodhouse Moor and the Grammar School.

Iron and Steel Institute.—The eighth annual meeting of this Institute was held on the 20th inst. at the Westminster Palace Hotel. The total number of members elected during the year 1876 was 69. The number on the books at the end of December was 946. The autumn meeting of the year 1876 was held at Leeds. At that meeting a communication was received from Sweden inviting the Institute to pay a visit to that country during the summer of 1877. The council were, owing to the death of Mr. David Forbes, compelled to abandon the idea of going to Sweden in 1877. At the meeting in Leeds particular attention was called to the advisability of taking some action for procuring a distribution of a portion of the property held by the Royal Commissioners of the Exhibition of 1851, for the purpose of promoting technical education in the more important of our manufacturing and industrial districts. Since that time the Council have placed themselves in communication with various Science Colleges and Technical Institutions throughout the country, and they have made arrangements to hold a Preliminary Conference between the representatives of these various bodies, with a view of determining upon the course of action that it will be advisable to pursue in connection with this matter. The Council have awarded the Bessemer medal for this year to Dr. John Percy, of the Royal School of Mines. The next Annual Meeting is to be held at Newcastle-on-Tyne. The members met at the rooms of the Institute of Civil Engineers on the 21st and 22nd inst., when an address was delivered by the President, Dr. Siemens, F.R.S., and papers were read by Mr. I. Lowthian Bell, M.P., and Mr. E. Riley, &c.

MEETINGS FOR THE WEEK.

Monday, April 2nd.—Royal Institution, 2. General Monthly Meeting.
Tuesday, 3rd.—Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 4th.—Society of Arts, 8. "The Pioneer Railway," by F. J. Rowan.
—— Microscopical, 8.
—— Pharmaceutical, 8.
Thursday, 5th.—Chemical, 8. "Lecture on the Discrimination of Crystals by their Optical Characters;" experimentally illustrated, by Prof. N. S. Maskelyne, F.R.S.
Friday, 6th.—Geologist's Association, 8.

THE
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E CHEMICAL NEWS.

VOL. XXXV. No. 906.

LEGED DISCOVERY OF A NEW METAL.

a communication made to the *Société des Sciences iques et Naturelles de Bordeaux* we learn that M. Prat liscovered a new metal, which, in honour of Lavoisier, lls Lavœsium. This new metal is of a silvery white r, malleable and fusible. It forms crystallisable and rless salts. The following are some of its reactions: hen treated with potassa a hydrated white precipitate is obtained, insoluble in an excess of the precipitant. Ammonia gives a precipitate very soluble in excess. Ferro-cyanide of potassium gives a characteristic precipitate similar to the colour of the petals of *roses du Bengale*. With hydrosulphuric acid a brown colouration is first obtained; the precipitate afterwards changes to a fawn colour. Tannin gives a deep yellow-green precipitate.

In the spectroscope the new metal gives:—1. In the indigo-blue two sets of characteristic lines. 2. In the bright green two other sets of simpler lines, also characteristic. 3. Some blue, violet, and green secondary lines; in all twenty-three lines. These characteristic lines exactly coincide with those of copper, which would seem to show that the new metal contains copper. Its silvery white colour, however, and some of its reactions, especially those with ammonia and ferrocyanide of potassium, constitute properties which distinguish it from any other known metal. According to M. Prat this body is much more common than he at first supposed, it having been found in many minerals, and especially in iron pyrites. If Lavœsium really exists its therapeutic action and its industrial uses remain to be studied.—*Correspondance Scientifique* from *Le Monde Pharmaceutique*.

ON THE RELATIONSHIP OF STRUCTURE, DENSITY, AND CHEMICAL COMPOSITION OF STEEL.*

By Prof. JOHN W. LANGLEY.

AT the present day much attention is being given to the importance of studying the connection between the chemical composition and physical properties of matter—meaning by physical properties such characteristics as crystalline form, colour, hardness, specific gravity, &c. The following paper is offered as a slight contribution to this department of knowledge.

There are two methods of investigating this subject: first, to take bodies whose chemical nature is intimately known, and to commence an examination of their physical character; the second, to take material long known and studied from the mechanical side, and to investigate its chemical composition. The latter is the method here followed.

Steel, from its great industrial importance, is the best known of all alloys, and its behaviour under mechanical forces has been most extensively studied, both by individuals and governments; but, unfortunately, the elaborate tables of tensile strength, elasticity, &c., thus produced, have not been supplemented by correspondingly thorough chemical analyses, because it has only very recently been surmised that slight variations in the composition of steel affect its behaviour more radically than do all the processes of the rolling-mill or the machine-shop. Within the last eighteen months the United States have appointed a commission to study in detail the connection between the strength, elasticity, &c., of steel and iron, and their chemical composition as shown by analysis. The research, which is the basis of this paper, was commenced before the organisation of the U. S. Commission; but after the general government decided to take up the subject and to explore it for the benefit of engineers, all that part of the original design was, of course, abandoned, and our attention has been chiefly directed to a study of the chemical and molecular structure of steel—a field which it is probable will not be entered upon by the Government Commission.

In such an undertaking the number of facts to be acquired and of subjects to be pursued in detail is very great; they are thus far in a very incomplete state, and I am therefore able to furnish a record of a portion only of the work done—that which merely serves as a foundation for future research. In March, 1874, Messrs. Miller, Metcalf, and Parkin, steel manufacturers, of Pittsburg, selected eight samples of steel which were believed to form a set of graded specimens, the order being based on the quantity of carbon which they were supposed to contain. They were numbered from one to eight. On analysis the quantity of carbon was found to follow the order of the numbers, while the other elements present—silicon, phosphorus, and sulphur—did not do so. As the method by which these samples were selected has an important bearing on the subject in hand, it will not be out of place to describe it.

The steel is melted in black-lead crucibles capable of holding about 80 lbs.; when thoroughly fluid it is poured into cast-iron moulds, and when cold the top of the ingot is broken off, exposing a freshly-fractured surface whose plane is approximately at right angles to the axis of the ingot. The appearance now presented is that of confused groups of crystals, all appearing to have started from the outside and to have met in the centre: this general form is common to all ingots, of whatever composition, but to the trained eye, and only to one long and critically exercised, a minute but indescribable difference is perceived between varying samples of steel, and this difference is now known to be owing almost wholly to variations in the amount of combined carbon, as the following table will show. This consists of twelve samples selected by the eye alone in April, 1875, and the analyses were made from drillings taken direct from the ingot before it had been heated or hammered.

TABLE I.

Ingot Nos.	Iron by Diff.	Carbon.	Diff. of Carbon.	Silicon.	Phos.	Sulph.*
1	99·614	0·302	—	0·019	0·047	0·018
2	99·455	0·490	0·188	0·034	0·005	0·016
3	99·363	0·529	0·039	0·043	0·047	0·018
4	99·270	0·649	0·120	0·039	0·030	0·012
5	99·119	0·801	0·152	0·029	0·035	0·016
6	99·086	0·841	0·040	0·039	0·024	0·010
7	99·044	0·867	0·026	0·057	0·014	0·018
8	99·040	0·871	0·004	0·053	0·024	0·012
9	98·900	0·955	0·084	0·059	0·070	0·016
10	98·861	1·005	0·050	0·088	0·034	0·012
11	98·752	1·058	0·053	0·120	0·064	0·006
12	98·834	1·079	0·021	0·039	0·044	0·004
	Mean	.. ..	0·071			

Here the carbon is seen to increase in quantity in the order of the numbers, while the other elements, with the exception of total iron, bear no relation to the numbers on the samples.

It has long been known that the structure of cast-steel, as visible to the eye, bears some relation to the quantity of carbon present, and a rough classification by this method has been in practical use; but the above analyses

* Read at the Buffalo Meeting of the American Association for the Advancement of Science.

* The determinations of sulphur were made by Pro A. R. Le[illegible] of Hoboken, N. J.

TABLE II.

Specific Gravities of Twelve Samples of Steel from the Ingot; also of Six Hammered Bars, each bar being over-heated at one end and cold at the other, in this state plunged into water, and then broken into pieces of equal length.

	1	2.	3.	4	5.	6.	7.	8.	9.	10.	11.	12.
Ingot	7·855	7·836	7·841	7·829	7·838	7·824	7·819	7·818	7·813	7·807	7·803	7·805
BAR.												
Order of samples from bar—												
Burned 1	—	—	7·818	7·791	—	7·789	—	7·752	—	7·744	—	7·690
2	—	—	7·814	7·811	—	7·784	—	7·755	—	7·749	—	7·741
3	—	—	7·823	7·830	—	7·780	—	7·758	—	7·755	—	7·769
4	—	—	7·826	7·849	—	7·808	—	7·773	—	7·789	—	7·798
5	—	—	7·831	7·806	—	7·812	—	7·790	—	7·812	—	7·811
Cold 6	—	—	7·844	7·824	—	7·829	—	7·825	—	7·826	—	7·825

The temperature to which the densities are referred is 60° F.

show a very close connection between composition and structure, for differences of carbon so slight as seven-hundredths of one per cent will impress such a change in the crystalline appearance of the metal that the eye of the expert can detect it, rarely ever making a mistake when the total carbon rises to a half per cent or more. In mild steels the discrimination is less perfect.

The appearance of the fracture by which the above twelve selections were made can only be seen in the cold ingot before any operation, except the original one of casting, has been performed upon it. As soon as it is hammered the structure changes in a most remarkable manner, so that all trace of the primitive condition *appears* to be lost; but although the crystalline form thus seems to be destroyed by heat or pressure, it can again be rendered evident by a special mode of treatment.

Another method of rendering visible to the eye the molecular and chemical changes which go on in steel is by the process of hardening or tempering. When the metal is heated and plunged into water it acquires, as every one knows, an increase of hardness, but also suffers a loss of ductility. If the heat to which the steel is raised just before plunging is too high, the metal acquires intense hardness, but it is so brittle as to be worthless; the fracture is of a bright, granular, or sandy character. In this state it is said to be *burned*, and it cannot again be restored to its former strength and ductility by annealing; it is ruined for all practical purposes, but it is in just this state that it again shows differences of structure corresponding with its content in carbon. The general nature of these changes induced by heat and tempering are sufficiently marked to be visible to an untrained eye, and can be illustrated by plunging a bar, highly heated at one end and cold at the other, into water, and then breaking it off in pieces of equal length, when the fractures will be found to show appearances characteristic of the temperature to which the sample was raised.

The great molecular changes thus rendered evident are probably accompanied by changes of a chemical character between the iron and the carbon. According to Caron such combinations do really occur, but the subject has thus far been too little investigated to warrant any decided expression of opinion.

There is a physical property which is well known to be intimately connected with chemical structure, viz., density, and in the case of union between gases it has risen to be sometimes even the criterion of combination. The specific gravity of steel and iron has been taken many thousand times before this, but not usually in conjunction with analysis; it is believed that a study of the densities of a series of steels under varied conditions, and as a sequel to analytic work, would develop facts of interest. Accordingly, samples were taken from the above twelve ingots by boring out a piece with a crown drill, breaking off the core left by the tool, and then grinding and polishing the surface smooth; also six bars drawn from the ingot were heated to *burning* at one end and were left cold at the other, then plunged into water, thus forming sets like the fractures just alluded to; each bar was then broken into six pieces and the ends rendered smooth, so that the specific gravity could be taken.

In the table above the results are given: the upper horizontal line contains the numbers belonging to the ingots; the left-hand vertical column gives the order of the pieces broken from the bars.

It is thus seen that the density decreases with the increase of carbon up to No. 5, which contains eight-tenths of 1 per cent of carbon; below this number the influence of various physical conditions—such as the rapidity of cooling, degree of fluidity before casting, &c.—influence the specific gravity in an apparently erratic manner, though the numbers still continue to vary inversely as the carbon in a general sense; also if the influence of temperature on density is noted with regard to the sets of hardened samples, it will be seen that, taking the numbers from 12 to 6 (or those containing the highest amount of carbon), the specific gravity is lower the higher the temperature applied. Finally, the lowest horizontal line shows the densities of the metal as it left the hammer, and the upper horizontal ones belonging to the bars the expansion produced by over-heating. By the influence of hammering, all the pieces have been brought to nearly the same density, but as soon as the *burning* point is reached the steel is brought back nearly to the condition which it had at the moment of casting, and now the specific gravity is seen to vary in the same sense as the numbers in the ingot line above it.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Thursday, March 29th, 1877.

Professor ABEL, F.R.S., President, in the Chair.

AT this meeting the President delivered his annual address, giving an account of the progress and present state of the Society, from which it appears that the increase during the past year has only been 35, making the total number of Fellows 919. The losses by death have been 16:—T. Charlesworth, F. C. Devigne, H. Deacon, Paul de la Rue, David Forbes, A. Harvey, J. Hearder, F. H. Hobler, A. S. Hobson, C. Lambert, L. A. Lucas, M. Lichtenstein, G. Parry, Alfred Smee, F. Smith, and T. H. Wyndham, besides one foreign member, M. Balard, the distinguished discoverer of bromine. Seven foreign members have been elected, namely, Professors Bæyer, Boutlerow, Cooke, Friedel, Heintz, and Thomsen. The number of communications brought before the Society last year was 70, being more than in any previous year, besides two lectures, the one "On Certain Methods of Physico-Chemical Research," by Professor Andrews, and the other "On the Theory of the Bunsen Flame," by Professor Thorpe. The fund for the promotion of chemical research has

made very satisfactory progress, and now amounts to more than £3000, including the munificent donation of £1000 by Dr. Longstaff and a like amount given by the Goldsmith's Co. The state of the ordinary income of the Society, however, is much less favourable, owing to the small increase in the number of Fellows as compared with former years, being less than half what it was last year, and less also than in any of the four previous years. There is but little doubt that the cause of this very serious falling off is to be ascribed not only to the blackballing which has been taking place for some time past, but the effect which certain instances of manifestly unjust exclusion by this means has had in deterring candidates from offering themselves for election. This system of blackballing is pursued by a small section of those Fellows who regularly attend the meetings, as is evident from the fact that the number of black balls does not exceed eight or nine; as, however, one-fourth negative balls suffices to exclude a candidate, this ensures the blackballing of the candidate unless the attendance of Fellows is numerous at the commencement of the meeting. It was to be hoped, however, that the injurious effects of their mode of action, which is most seriously imperilling the future prosperity of the Society, would induce them to give the matter their serious consideration. The President then gave an account of the negociations which had taken place between the Council and the Committee for organisation amongst professional chemists, which had since developed into the "Institute of Professional Chemists," and noticed the alteration which had been made in the Fellows' certificate for election, and the reasons which had induced the Council to propose the alterations in the bye-laws, which were to be submitted to them that evening.

The TREASURER then read his Report, Messrs. Carteighe, Friswell, and Nicholson being auditors.

Mr. E. NEISON said he would like to draw the attention of the Fellows to two or three matters before the adoption of the President's Report was moved, and then pointed out (1) that, although the general index to the Society's *Journal* had cost a large sum, £282, comparatively few copies had been sold; he thought it would be advisable to distribute the index gratuitously to the Fellows. (2) He stated that the laboratory was very insufficiently supplied with apparatus and chemicals, and suggested that when the Society granted money to chemists for assisting them in conducting original research they might at the same time place the laboratory at their disposal. (3) That a very long time, three or four months or more, elapsed between the reading of a paper at one of the Society's meetings and its appearance in the *Journal*, and concluded with some remarks on the blackballing which has recently taken place in the Society.

Professor WILLIAMSON remarked that it was most important that some appropriate occasion should be offered for the discussion of various matters affecting the welfare of the Society, and was very glad that they now had an opportunity of talking over this matter of the blackballing together. He was very jealous of the privilege or rather duty of the Fellows of excluding those candidates who were not properly qualified, but at the same time this function should be exercised with the greatest discretion. No doubt this action had been taken on some principle, but it was a principle which he did not understand, and if, instead of producing the effect they desired, it had produced others of an unexpected and perhaps disastrous character, he hoped those members who had exercised this privilege would reconsider their mode of action, which, if continued, would produce very serious injury to the well-being of the Society.

Mr. KINGZETT made some remarks on the subject of blackballing, and also complained that a paper by Dr. Hake and himself read before the Society in January last had been returned to him by the committee of publication with suggestions that he should make certain alterations in it before it was published in the Society's *Journal*.

Dr. THUDICHUM made a similar complaint; several of his communications had been treated in the same way. He had addressed a solemn letter to the Council on the subject, but had received no reply.

Dr. ODLING said that the management of the affairs of the Society was entrusted to the Council by the Fellows; some of the papers were undoubtedly delayed, but only those papers which the publication committee did not at first see their way to recommend for publication, and which were referred to be specially reported on. Some sort of censorship must be exercised; it would be very unreasonable to ask them to undertake to publish indiscriminately every paper which might be presented. With regard to the blackballing, he quite agreed with Dr. Williamson that it was most important that the privilege should be exercised with the greatest discretion, but in this case it was evident that a small section of the Society, a minority of 8 or 9 members who regularly attended the meetings, were thwarting the wishes of the majority, since one black ball in four was sufficient to reject a candidate.

Mr. E. RILEY thought it would be far better to adjourn this discussion and proceed with the business of the evening; he therefore begged to second the motion that the Report of the President be received.

It was moved by Mr. KINGZETT as an amendment, and seconded by Dr. THUDICHUM, that the words "unjust" and "indiscriminate" in the Report as applied to the blackballing be omitted.

The amendment was then put by the PRESIDENT, but only 12 members voted for it out of the crowded meeting; the original motion was then put and carried.

The election of Officers and Council for the ensuing year was then proceeded with, Messrs. Riley, Carteighe, and Neison being appointed scrutators. The following gentlemen were elected:—

President—Dr. J. H. Gladstone.

Vice-Presidents—F. A. Abel, Sir B. C. Brodie, Warren de la Rue, E. Frankland, A. W. Hofmann, W. Odling, L. Playfair, A. W. Williamson, T. Andrews, W. Crookes, F. Field, J. H. Gilbert, H. E. Roscoe, J. Stenhouse.

Secretaries—W. H. Perkin and H. E. Armstrong.

Foreign Secretary—H. Müller.

Treasurer—W. J. Russell.

The other members of Council are J. Attfield, I. Lowthian Bell, A. H. Church, C. E. Groves, W. N. Hartley, C. W. Heaton, T. H. Hills, David Howard, G. Matthey, J. A. Phillips, R. V. Tuson, and C. R. A. Wright.

A vote of thanks to the retiring President, Professor Abel, which was received with acclamation, was proposed by Professor WILLIAMSON and seconded by Dr. WARREN DE LA RUE. There were also votes of thanks to the Officers and Council proposed by Mr. CARTEIGHE and seconded by Mr. TENNANT; to Mr. Watts and the abstractors by Dr. ODLING and Mr. CROOKES; and to the Auditors by Dr. RUSSELL and Dr. PAUL.

Professor ABEL then dissolved the meeting, and resolved it into a special general meeting to consider some alterations in the bye-laws, when the new President, Dr. Gladstone, took the chair.

Mr. NEISON proposed some verbal alterations; a discussion arose as to these resolutions being brought forward without notice. Mr. Neison ultimately agreeing to postpone the matter until the next annual meeting.

The following alterations in the bye-laws, proposed by the Council, were then put to the meeting and carried unanimously.

In Paragraph II. of the bye-law relating to associates. (*a*) The words at the commencement of the second paragraph to be—"Associates shall pay an annual subscription of one pound." (*b*) The following words to be added at the termination of the second paragraph—"but they shall have the option of paying an annual subscription of thirty shillings in place of one pound, for which subscription they shall be entitled to a copy of the Society's *Journal*, in addition to the ordinary privileges of Fellow with the exceptions hereinbefore specified." Also

new form of obligation to be signed by Fellows on their admission (the words in italics being the additions to the old form).

"I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Chemical Society, *that I will* observe its Laws, and *to the utmost of my power maintain* its dignity, as long as I shall continue a Fellow thereof."

The meeting was then adjourned until Thursday, April 5.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, February 22nd, 1876.

The President in the Chair.

The Secretary read the following papers:—

"*On a Water-Box Deposit*," by J. T. Dunn. This deposit, which I received from Mr. M. Fryer, was formed last autumn in a water-box in the shaft of the Jane Pit at Walker. The box has been filled up until its sectional area is reduced from 7½ square inches to less than half a square inch, and in places it is almost completely closed.

The deposit consists of alternate whitish and brown layers, the white layers being generally much thicker than the brown ones in the upper portions of the box, but the brown layers increasing in thickness further down the shaft. The deposit is moderately soft, much resembling "Bath brick" in texture, and is readily pounded, the colour of the powder being a light buff.

Hydrochloric acid boiled upon the powder dissolved only a very small proportion, and the residue was perfectly white. The acid solution was yellow, and contained iron.

A spectroscopic examination of the residue revealed the presence of barium, strontium, and calcium. With a view of arriving at a rough estimate of the relative proportions of these metals, a portion of the powdered deposit was decomposed by fusion with sodium carbonate, the fusion was extracted with water, the insoluble portion well washed, and dissolved in hydrochloric acid.

The water solution showed a very large amount of sulphuric acid, and a small quantity of silica.

The acid solution gave a small amount of ferric oxide and alumina, a large quantity of barium, a much smaller quantity of strontium, and very little calcium.

The composition of the deposit may then be roughly represented as follows:—

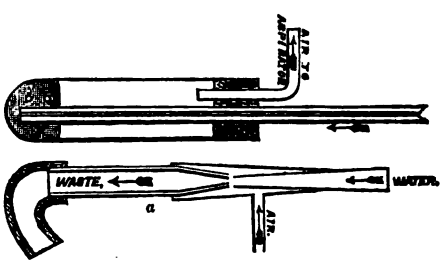
	Per cent.
Barium sulphate, about	90
Strontium sulphate, about	8
Calcium sulphate, about..	1
Silica, alumina, ferric oxide, &c., about	1

The water showed on analysis small quantities of ferric oxide, silica, alumina, and sulphuric acid, a moderately large quantity of calcium carbonate, and a large amount of potassium and sodium chlorides, the total quantity of solid matter being about 800 grains per gallon; but, although about 2 gallons of the water was evaporated, no trace of barium or strontium could be found.

The presence of barium and strontium in the deposit remains, therefore, as yet unexplained, but I have not yet ascertained whether the deposit is still forming, or was forming when the sample of water for analysis was taken.

In connection with this deposit it is interesting to note that about twenty years ago a similar deposit was formed in one of the pits at Walker, which was found by Dr. Richardson to contain about 90 per cent of barium sulphate and 3 per cent of calcium sulphate, the rest being silica, alumina, ferric oxide, and moisture; and I believe that in this deposit also the presence of barium was unaccounted for. This old deposit has since been re-examined for strontium, but gave negative results. I have not yet been able to discover whether the two deposits came from the same pit.

"*Laboratory Notes*," by H. R. Procter, F.C.S. Observing that the Fletcher aspirator is to be exhibited at the ensuing meeting, I venture to describe one which I employ in my own laboratory with very satisfactory results. It is practically that described on p. 163 of the last volume of the Chemical News, by A. Percy Smith, and consists of two tapered jets diametrically opposed to each other. I found, however, that in the original construction it was difficult to secure the necessary rigidity and exact centering of the tubes, and therefore employed some fragments of a common blowpipe soldered together, as annexed, and with a glass waste-pipe cemented into it at *a*. Over the lower end of this is slipped a piece of india-rubber tube for the double purpose of checking the current (which is essential to efficient suction), and of conducting the water and air which are discharged into other apparatus. I am convinced that my arrangement is far less efficient than the principle would permit with better workmanship; but, even as it is, a moderate water pressure rapidly produces a vacuum of 28 or 29 inches of mercury. The uses to which such an exhaustor can be put are very varied. Not to speak of vacuum filtration, I have found it most available for distillations *in vacuo*. Two flasks are connected in the usual way with a Liebig's condenser by tightly fitting india-rubber corks, one of which is pierced by a small tube connected with the aspirator. As soon as the apparatus is exhausted, the connection is closed by a pinch-cock, when a very gentle heat is applied to the flask containing the liquid will cause it to distil rapidly, and without any possibility of loss. The same arrangement may be employed for evaporating to dryness at a low temperature liquids containing changeable organic substances; or the flask containing the liquid may simply be immersed in warm water, and connected directly with the aspirator, when the evaporated liquid will be condensed and washed away with the waste water.



For such uses it is necessary to have some arrangement to render it impossible for water from the pump to recede into the connected apparatus, as it is apt to do if the water pressure varies from any cause, such us turning on an adjacent tap. The best india-rubber valves I was able to construct were apt to leak or fail at the critical moment; but at last I hit on an arrangement, which was not only very simple but gave absolute security. A piece of slender barometer tube, slightly over 30 inches long, was fitted by a tight fitting cork into a test-tube containing a little mercury. The flasks, &c., were connected with the upper end of this tube, while the aspirator tube was passed through the cork into the test-tube. As the exhaustion proceeds the air bubbles through the mercury, but it cannot recede, since to do so it must force the mercury up the narrow tube. The mercury therefore forms an absolutely perfect valve, and may also serve as a pressure gauge, since on turning off the water it immediately rises till it balances the minus pressure of the vacuum.

I have lately made a laboratory barometer, which is both simple and accurate. A millimetre scale is etched on the tube by Bunsen's well-known method, and by the same means a zero mark is made near the bottom. The reservoir consists of a test-tube fitted on with a notched, or rather a split, cork, and the whole is hung to a hook by a little loop of copper wire at the top. A small loop of sheet copper should also pass round the test-tube below to prevent any risk of its sliding too low on the tube and

admitting air. The mercury is of course brought to zero before an observation by sliding the test-tube. In filling it with mercury, the mercury is boiled in the tube as usual, and then a small piece of india-rubber cemented on the bottom of the test-tube is firmly pressed on the end of the barometer tube, the whole turned upside down, and a little more mercury added.

"*Note on Esparto Slag*," by A. J. M. EDGER and B. S. PROCTOR. Some time ago, when a great fire occurred at Boldon, resulting in the burning of a large store of Esparto grass, our friend, Mr. W. S. Scott, had the curiosity to collect a few pieces of the semi-fused ash of the grass, as free as possible from any contamination, and submit a portion to the heat of one of his pottery kilns. The result was the production of a very good sample of bottle glass. Thinking that the subject might be of some interest to our members, we sought and readily obtained from him specimens of the slag and the glass resulting from its fusion, which are now presented to the meeting.

Mr. Scott also informs us that when a corn stack happened to be burnt down in his neighbourhood some years ago, he made a similar experiment, the resulting glass being rather more darkly coloured. Of this he has unfortunately not preserved a specimen.

The Esparto slag, by analysis, yields the following:—

	Per cent.
Silica	64·60
Peroxide iron	3·27
Protoxide iron	0·25
Protoxide manganese	0·75
Lime	10·50
Magnesia	6·25
Potassa	0·82
Soda	9·88
Phosphoric acid	3·38
	99·70

This, when put in comparison with the English grasses, stands far above them in richness in silica; the average percentage of silica being about 35 per cent, with 42 per cent of basic materials, but the proportions varying much with species and with circumstances, the silica ranging from 16 per cent to 63 per cent in the grasses, and from 20 per cent to 80 per cent in the cereal straws, the average percentage in the latter being about 60 per cent.

Comparing the slag with the following tables of the composition of bottle glass, there is a strong analogy between the better quality of bottle glass and the slag, with the exception of an excess of iron in the Esparto slag, and a notable absence of alumina.

	Black Bottle Glass varies from	Average.	Medical Bottle Glass varies from	Average.
Alkalies	3·0 to 6·0	4·5	10·4 to 11·0	10·70
Lime	18·0 to 29·0	23·5	10·0 to 16·0	13·00
Magnesia	7·0	3·5	0·6 to 2·2	1·40
Protoxide of manganese	1·2	0·6	0·5 to 1·2	0·76
Peroxide iron	4·0 to 6·0	5·0	0·7 to 2·5	1·60
Alumina	6·0 to 14·0	10·0	2·4 to 4·5	3·50
Silica	45·0 to 60·0	52·5	62·0 to 71·6	66·30
				97·26

To make the comparison more striking we may group the materials together according to their analogies, and compare the slag with average medical bottle glass as follows:—

	Esparto Slag.	Average Medical Bottle Glass.
Alkalies	10·70	10·7
Alkaline earths	16·75	14·4
Oxide of iron, manganese, and alumina	4·27	5·8
Silica	64·60	66·3

This comparison, equally with the specimen on the table, shows how readily a fire of such materials might, under favourable circumstances, lead to the discovery of glass.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

March 26th, 1877.

Prof. A. BAEYER, Vice-President, in the Chair.

PROF. A. W. HOFMANN stated, in connection with the late communications "*On Mono-methyl Aniline*" (CHEMICAL NEWS, vol. xxxv., p. 104), that he had obtained this compound by the action of methylic chloride, bromide, and iodide upon aniline, the latter in excess. Dimethyl aniline, regarded by Kern as the sole product, is produced in equal proportions with mono-methyl aniline, when CH_3Cl is used, and in the proportion of 3 : 1 when CH_3I is used, —CH_3Br giving intermediary results. Mono-methyl aniline is obtained quite pure in the form of the acetyl compound by simple distillation of the products of the reaction with acetic anhydride. Commercial dimethyl aniline is found to contain in all cases variable amounts of mono-methyl aniline.

Prof. A. BAEYER communicated the latest results of his investigations "*On Phenol-Phthalein*." By treatment with HKO it is decomposed into benzoic acid and dioxybenzophenon, $CO(C_6H_4OH)_2$, a body obtained in fine colourless crystals.

Prof. A. BAEYER also gave at length various theoretical considerations inclining him to bestow upon "*Furfurol*," $C_5H_4O_2$, a constitutional formula in which four carbon atoms are joined together in a ring, as in the case of benzene.

Prof. O. WALLACH described "*Chlorine Derivatives of Aceto-phenon*." By the action of chlorine alone, besides $C_6H_5COCH_2Cl$, he has obtained $C_6H_5CO_2Cl$. With PCl_5 aceto-phenon forms $C_6H_5CClCHCl$, which easily takes up two additionol atoms of Cl and forms $C_6H_5CCl_2CHCl_2$.

By the "*Reduction of Chloralide*" he has obtained dichlor-acrylic acid, CCl_2CHCO_2H. This compound does not unite with two additional halogen atoms as would be expected, the presence of chlorine seeming to affect the additive properties of acrylic acid.

Prof. A. OPPENHEIM and R. HELLON described "*Ethyl-propionyl Propionate*," $C_2H_5CO.C_2H_4COOC_2H_5$, the next higher homologue of ethyl-acetyl acetate, obtained among a variety of condensation products resulting from the action of sodium upon ethyl propionate. It is a mobile liquid, with characteristic odour and taste, boiling at 200°, and dissolving sodium with ease. The authors were unable to separate out analogous compounds from the liquid products resulting from the action of sodium on ethyl butyrate and isobutyrate.

Prof. A. OPPENHEIM and T. H. NORTON gave an account of a new acid, "*Thiorufinic Acid*," $C_{10}H_{14}S_3O_4$, obtained by the action of CS_2 on the mixture of sodium ethylate; and sodium ethyl-acetyl acetate, resulting from the solution of sodium in ethyl acetate, and apparently a condensation product of xanthic acid, and the analogous derivative of ethyl-acetyl acetate. The acid and its salts crystallise in brilliant crimson needles. The salts of the heavy metals are exceedingly insoluble. Treatment with N_2OH yields alcohol, and a new acid likewise of a bright crimson colour, and exceedingly soluble in water.

The same described also "*Carbo-thio-ethyl-acetyl Acetate*," $CH_3CO.C(CS)COOC_2H_5$, obtained by the action of PbO and CS_2 upon ethyl-acetyl acetate. It crystallises in yellow needles, and is sparingly soluble in ordinary solvents.

The following communications have been received from non-resident members:—

F. WÖHLER, "*On the Separation of Arsenic from Nickel and Cobalt*." In order to avoid the precipitation with H_2S, the author dissolves the minerals to be analysed, in aqua regia, and adds Na_2CO_3. The precipitate is treated with oxalic acid, and the insoluble oxalates of the two metals thus obtained are easily and completely separated from

E. SCHUNCK and H. RŒMER, "*On Purpurin.*" The authors find that purpurin by heating to 300° is changed into chinizarin. Purpurin is also distinguished from analogous compounds by uniting with but a single molecule of bromine.

P. FRIEDLANDER, "*On Diphenylen-Glycollic Acid.*" This acid, $(C_6H_4)C.(OH).(COOH)$, is obtained by the action of HNaO on phenanthrenquinon. By oxidation it yields diphenylen-keton, $(C_6H_4)_2CO$; by heating with water, at 160°, benzhydrol, $(C_6H_4)_2CH.OH$; and by reduction, diphenylen-acetic acid, $(C_6H_4)_2CH.COOH$, which changes easily into fluoren.

H. HÜBNER and K. BUCHKA, "*On Phenoxylic Acid.*" By the action of HCl on benzoyl cyanide, at 140°, the authors obtain a yellow crystalline compound,—

$$(C_6H_5COCN)_2H_2O,$$

which yields, with alkalies or acids, phenoxylic acid,—

$$C_6H_5COCOOH.$$

It crystallises in colourless needles, melts at 111°, is very soluble in water, and forms crystalline salts.

L. CLAISEN describes an acid of the same composition, resulting from the action of HCl on C_6H_5COCN at an ordinary temperature, melting, however, at 66°.

F. FITTICA, "*On Nitro-benzoic Acids.*" Additional particulars are given with regard to the fourth isomeric nitro-benzoic acid announced by the author in 1875. He has now succeeded in obtaining it by the action of ethylic nitrate on an ethereal solution of benzoic acid, in the presence of concentrated sulphuric acid. The acid melts at 127°, and is soluble in 380 parts of water. The free acid cannot be changed into its isomers by repeated crystallisations or heating beyond the melting-point. This change is, however, possible in the salts. The barium salt, after repeated crystallisations, yields with HCl meta-nitro-benzoic acid; melting-point, 142°. The ether was obtained by the slow action of ethylic iodide on the silver-salt at a low temperature. It forms yellow needles, and melts at 37°. The fourth isomeric amido-benzoic acid, obtained by reduction from the nitro-acid, melts at 156°, and in the form of the ammonium-salt can be changed into metamido-benzoic acid by prolonged heating. Another nitro-benzoic acid, melting at 135°, prepared by the action of HNO_3 and H_2SO_4 on benzoic acid at a low temperature, is regarded as a physical isomer of the acid melting at 127°, because it possesses the same solubility and yields the same ether and amido-benzoic acid. The author has further obtained two nitro-benzoic acids possessing the same melting-points as meta-nitro-benzoic acid, 142°, and the fourth nitro-benzoic acid, 127°, but characterised by a greater solubility in water and by the bright lemon-colour of not only the acids, but also the salts and ethers.

"*On Benzoic-nitro-benzoic Acid.*" This acid is prepared in the form of the ether, by the slow addition of an ethereal solution of benzoic acid to concentrate H_2SO_4. Saponification with potash yields the free acid. The author gives it the formula—

$$C_6H_5COOH.C_6H_4.NO_2.COOH,$$

and regards it as a molecular compound, although the ether can be distilled without decomposition. A similar acid was obtained from benzoyl-chloride and ethyl-nitrate. The author has succesively applied the above-mentioned reactions for the preparation of nitro-acids to other aromatic acids.

M. FILETI and R. SCHIFF, "*On the Constitution of Cyanamide.*" By the action of chloral on cyanamide the compound $NC.NH_2C_2Cl_3OH$ was obtained, and by treating $CN.NAg_2$ with C_2H_5I diethyl cyanamide, $CN.N(C_2H_5)_2$, was prepared, from both of which reactions the authors regard the formula of $NC.NH_2$ for cyanamide as much more probable than NH.C.NH.

E. VON SOMMARUGA and E. REICHARDT state, in a preliminary communication on the "*Action of Ammonia on Isatin,*" that they have obtained two crystalline bodies differing from those mentioned by Laurent in his investigations on the subject.

A. C. CHRISTOMANOS, "*On Iodine-Trichloride.*" The best method for the preparation of this compound, free from iodine, is found to be that of mingling gaseous HI and Cl:—$HI+2Cl_2=HCl+IC_3$. The bright yellow trichloride thus obtained melts at 33°, and changes into a yellow gas at 47·5°. Chlorine gas is the only medium in which it can be preserved indefinitely. In air, oxygen, and especially hydrogen, it is extremely volatile. Phosphorus and potassium burn brilliantly if in contact with the solid substance. CS_2 is decomposed with a violent reaction. It acts as a strong oxidising agent with ferrous and sulphurous solutions.

L. WENGHÖFFER, "*Action of Sulphuryl-Chloride and Ethyl-Sulphuric Chloride on Aniline.*" The author does not find the reactions of $SO_2Cl.OC_2H_5$ entirely analogous to those of $COCl.OC_2H_5$. With aniline sulphanilic acid is produced:—

$$C_6H_5NH_2+SO_2Cl.OC_2H_5=$$
$$=C_6H_4(NH_2)(SO_3H)+C_2H_5Cl.$$

Acetanilide yields a more complicated body:—

$$2C_6H_4.NH.C_2H_3O+SO_2Cl.OC_2H_5=$$
$$=C_2H_5Cl+H_2O+SO_2(NHC_6H_5C_2H_3O)_2.$$

By the action of sulphuryl chloride on acetanilide, and subsequent elimination of the acetyl group, a body was obtained with the formula $C_6H_4.NH.SO_2$.

E. BLANKENHORN finds, in the course of experiments "*On the Action of Sulpho-cyanic Acid* in statu nascendi *on Alcohol,*" that a sulpho-allophanic ether is produced—

$$NH_2.CS.NH.CS.OC_2H_5.$$

By heating with NH_3 at 100° it is changed into sulpho-carbamide.

C. HELL and A. WALDBAUER have obtained from the "*Action of Alcoholic Potash on Mono-brom-iso-butyric Acid,*" ethyl-oxy-iso-butyric acid,—

$$(CH_3)_2C(OC_2H_5).COOH,$$

a colourless liquid, with ethereal odour, boiling at 180°, and slightly heavier than water. The salts are very soluble and crystallise finely.

C. HELL and E. MEDINGER, "*On the Oxidation of the Acid* $C_{11}H_{20}O_2$ *in Crude Petroleum.*" Both by treatment with HNO_3 and potassium bichromate it is oxidised into acetic acid, and a new acid, $C_9H_{16}O_2$, *a* nonylonic acid. The authors are of the opinion that the original acid contains no carboxyl group, on account of the decomposition.

A. NAUMANN, "*On the Decomposition of Molten Potash Alum in Sealed Tubes at* 100°." After melting, a gradual decomposition takes place, which consists of a separation of water of crystallisation, and precipitation of the anhydrous compound. The free water causes then, in the liquid portion, the separation of a basic compound of alumina, potash, sulphuric acid, and water.

K. ZULKOWSKY, "*On the Composition of Corallin.*" The author's experiments lead to the conclusions that the commercial dye-stuff known as corallin consists chiefly of the lustrous crystalline substance, rosolic acid, and a dull red resinous body, temporarily termed pseudo-rosolic acid, and yielding by oxidation a dark red compound. A body recently obtained by Liebermann and Schwarzer from phenol and salicylic aldehyd appears to be identical with the pseudo-rosolic acid.

R. NIETZKI, "*Decompositions of some Aniline Derivatives by passing through Heated Tubes.*" On passing dimethyl aniline through a glass tube, heated to a dull red-heat, large quantities of benzo-nitrile were formed. Acetanilide yielded, at a bright red-heat, diphenyl-carbamide.

L. PFAUNDLER, "*On the Temperature of the Vapours issuing from Boiling Solutions of Salts.*" The author seeks to explain the fact that a thermometer surrounded by these vapours always marks a lower temperature than that at which the solution boils, by the hypothesis that

the vapours consist of molecules of various temperatures, —some above and some below the temperature marked by the thermometer, and even of particles of water. When these come in contact with the surface of the thermometer the colder particles adhere, and as they are caused to evaporate by the collision with the more highly heated molecules, the passage into the gaseous state naturally causes a constant lowering of temperature about the bulb of the thermometer.

L. LOEWENHERZ, in a communication "*On Fundamental Thermometric Experiments*," states that a noticeable error in the height of the thermometer is to be observed when it is immersed in mercury, due to the external pressure on the bulb. A change, amounting in one instance to 0·3°, in the melting-point of ice, was also observed to ensue after thermometers had been kept for several days in boiling water.

NOTICES OF BOOKS.

Report upon Geographical and Geological Explorations and Surveys West of the One Hundredth Meridian. In charge of Lieut. G. M. WHEELER. Part VI., Vol. iii. —Geology. Washington: Government Printing-Office.

THIS Part contains investigations upon mineralogical and agricultural conditions observed in parts of New Mexico, Colorado, and Arizona. We notice an analysis of the mud of the Rio Grande, which, from the fertilising power of its inundations, has not inaptly been compared to the Nile. On the western slopes of Mount Graham a higher night temperature was observed at Camp Grant than at Eureka Springs, 500 feet lower. The author finds that certain plants growing along the slopes of a mountain chain will not thrive in the adjoining valleys—a marked example being the giant cactus (*Cereus giganteus*).

Ozonometric observations were carefully made, with the result that there is no difference in the amount of ozone between healthy and unhealthy localities. Such a statement might have been received with incredulity a few years ago, but the exaggerated views once entertained concerning the sanitary value of ozone have been latterly very much modified.

The whole report may be pronounced full of interesting facts, meteorological, geological, mineralogical, botanical, and agricultural.

Second Annual Report of the Commissioner of the Imperial Mint, Osaka, Japan, for the year ending June 30, 1876. Hiogo: Hiogo News Office.

THIS report gives interesting proof of Japanese progress in the industrial arts. Mr. Ohno, Superintendent of the Coppersmith Department, has made some forty balances, which compare very favourably with those made by Europeans. Sulphuric, nitric, and muriatic acids are now regularly made, not merely for the use of the mint, but for sale, and about 350,000 lbs. of the first-mentioned have been exported to China. With the exception of Mr. E. Dillon, the assayer, and Mr. W. Gowland, F.C.S., the chemist and metallurgist (to whose courtesy we are indebted for this report, all the high officials of the mint are now Japanese.

The Origin of the Sun's Heat and the Chemical Constitution of the Matter of His System. By W. COUTTIE. Troy, N.Y.: Scribner.

THE author of this pamphlet declares that "the teachings of chemistry are as local as our politics and as changeable as the weather." He asserts that he has discovered an element whose atomic weight is 5, and which, by combining with nitrogen, forms fluorine, chlorine, bromine, and iodine. With carbon it combines to form oxygen and silicon; and with hydrogen to form sulphur and lithium. Its combinations, direct and indirect, with hydrogen, carbon, and nitrogen form all the other elements except phosphorus.

Mr. Couttie makes grievous complaints of the prejudies of scientific men and their opposition to any new truth, if of eminent value. So far as we are enabled to judge no discovery would be so eagerly welcomed as one which should lessen the number of our present so-called elements by proving them to be compounds of a few simpler principles. But we cannot find in this pamphlet any evidence for the author's assertions. If an unknown element by combining directly with nitrogen forms iodine, let him tell us how we may decompose iodine and arrive at the experimental verification of his views. Or let him show us how to decompose oxygen into this same new element and carbon. Till this is done chemists must be excused if they decline to attend to Mr. Couttie's speculations.

CORRESPONDENCE.

BLOWPIPE REACTIONS.

To the Editor of the Chemical News.

SIR,—I was very glad to see in the CHEMICAL NEWS (vol. xxxv., p. 127) the reprint of Dr. Foster's paper, defending Turner's flux against the remarks made upon it by Prof. Chapman in his papers in this journal. Having worked a great deal for some years with the blowpipe, and having very often employed Turner's flux, I was immensely surprised to read what Prof. Chapman said about the test being "altogether superfluous" for boric acid. The statement that it fails to detect boric acid in borate of soda, and that in those cases where it *does* show the colouration the minerals *alone* show it equally well, was quite contrary to my own experience, and I could only wonder how anybody could arrive at results so very much opposed to those of, I believe, all other workers at the subject. My confidence in the very great value of the flux was not at all shaken, but I did not really know its full delicacy till I saw the account of Dr. Foster's experiments, showing its reliability even in presence of such very large amounts of its worst enemy, sodium. I have repeated these experiments with the most satisfactory results; indeed, I think that Dr. Foster might safely have expressed himself even more strongly than he did as to the distinctness of the colourations obtained with the mixtures of salt and borax. I also found that several specimens of tourmaline gave a *very vivid* colouration with the flux, even when the powder of the mineral was ground up with an equal bulk of common salt, though I could detect no green colour whatever when the powder alone was tested, either made to a paste with water or with strong sulphuric acid.

I should like to know whether Prof. Chapman holds an equally low opinion of the value of Turner's flux in testing for lithium. In his paper he only spoke of it in its application to boric acid, and Dr. Foster limits his reply to the same point, though probably he has ascertained its great value for lithium also. Its delicacy for this purpose quite equals, I think, that which it possesses for boric acid. I have made a few trials of it, by grinding powder of *petalite* with increasing quantities of other substances free from lithium, and testing the mixtures with the flux in the Bunsen flame and before the blowpipe. When using, for instance, powdered fireclay, which gave a moderately strong sodium flame by itself, I found that a mixture of 98 parts of this with 2 parts of petalite gave with Turner's flux a most decided lithium colouration in the extreme edge of the Bunsen flame, and a very distinct, though not equally intense, indication in the flame of the blowpipe-lamp. With 99 parts of clay and 1 part of petalite the colouration in the Bunsen flame was still unmistakable

with care, and still just visible in the blowpipe-flame. Unfortunately, the lithium test does not, like that for boric acid, withstand the presence of very much sodium, and the use of coloured glasses often becomes necessary.

In the new edition of "Plattner" Prof. Richter mentions the flux advised by Poole for detecting boric acid and lithium. It was not given in the former edition, but I have often used it, as Prof. Richter mentioned it to me and others in his instruction in blowpiping. I find it very good in testing for lithium, though not so good as Turner's, but I have always failed to find it of any value in testing for boric acid.

I have made several careful trials of the process recommended by Major Ross for detecting boric acid ("Pyrology," pages 191 and 192), but have not been successful, possibly through some fault of my own, though I think I have proceeded exactly as he advises. I find that when *Zoisite* (or any other suitable earthy mineral) is ground to a paste with a drop of solution of cupric sulphate, this paste, heated on platinum wire, gives a strong copper-green to the flame, which cannot be got rid of even by long blowing. Placed in the Bunsen flame, such paste colours it very distinctly after many minutes, and though the colour decreases in intensity after some time, still the same paste removed from the Bunsen, and again treated at the tip of a strong blowpipe-flame, gives a vivid green, although not quite as vivid as does the fresh paste. When this mass on the wire is removed, crushed again with water and a little tourmaline (as I understand the instructions), and again heated, the green colouration certainly becomes again very strong, as at first. But the same result was always obtained when the mass was re-crushed with water only, and no tourmaline added; just as substances which fuse or sinter in the forceps, and colour the flame less strongly after such fusion or sintering, will often give a stronger colouration again when powdered, made to a paste, and re-heated.

I must own that I did not *expect* to succeed, and was to this extent prejudiced; as all my experience of minerals containing copper oxide, or of minerals made into paste with copper solution in order to test for chlorine, has been to the effect that the green colouration is practically permanent. And even if I found that the addition to such paste of a mineral containing boric acid caused an increase in the intensity of the colouration, I should not feel nearly as safe in relying upon this increase of a colour already present as in relying upon the appearance, even for a few instants, of the sudden and intense change in the flame when Turner's flux is used.

I should be glad to know whether anybody else has tried this process and been more successful than I have been.—I am, &c.,

W. M. Hutchings.

Laboratory, Wallasey Ore Works,
Birkenhead, March 31, 1877.

MOSS COPPER, &c.

To the Editor of the Chemical News.

Sir,—The perusal of Prof. Liversidge's paper (Chem. News, vol. xxxv., p. 69), "On the Formation of Moss Gold and Silver" was a delicious treat to me, in common, I dare say, with many others. Sometimes, when I have ventured to hint at "gold growth," I have been politely referred, along with the "absurd idea," to the company of "Horse-Marines," as being, I suppose, fellows credulous to the *nth*. For several years I have been intently watching certain goings-on in my cabinets, because some of them appeared to be exceptional "*metal growths*," or, as others may prefer to put it, changes, protrusions, elongations, foliations, curlings, scrollings, movements, &c. At all hazards, for the present, I shall call them "growths." I do so because bones, in a sense, are said to grow. Why therefore, in a sense also, may not some stones in certain conditions? Most growth, I fancy, is aggregation. A year or more ago I promised to send you a description of some of these changes, more particularly as regards native gold. Since then, however, they have been so many and so frequent that I have reluctantly put off from time to time writing you thereon, because I had not enough leisure for the *condensation* of what had grown into a rather long story.

My neighbour Mr. Hutchings, I rejoice to see, has given several extremely interesting facts touching the formation of "moss copper." I shall now only allude to some moss copper got at Penzance a few years ago, and which was said to have "grown" in one night, "after a thirteenth fusion," and swept off ingots next morning—a very common occurrence, I was told at the time.

This "moss copper" (a specimen herewith) consists of filaments of various lengths and thicknesses, all more or less gracefully curled or twisted. The prevailing colours now are—Grey, yellow, red, violet, green, scarlet, and purple, in many shades; all brilliant, and some of them beautifully so. Nine or ten months ago, for convenience, I pressed down some of this copper moss into a small paper tray. It has since risen above the edges of the tray (mechanically, perhaps, for the most part), and in some places, with thread-like protrusions, an inch or more long. A few weeks since I took a pinch of it having what I fancied this singular propensity in rather noticeable degree, and put it into a little glass-topped paper box, keeping it within arm's length on my writing-table. One filament has now reached the under surface of the glass top, in an inch and a half "growth." It has got bent at almost a right angle, but has still its termination quite up to the top. Another growth, seven-tenths of an inch long, apparently prefers a nearly horizontal mode of proceeding. I offer no explanation of these metal movements. Most certainly artificial heat had nothing whatever to do with their origin. I mention the facts now, so that some of your readers who are mineral collectors may overhaul their cabinets, and particularly look out specimens of quartz showing native copper or gold. If they have not already observed it, they will probably find argentite and several allied minerals very elegantly sportive. The same will apply to arsenical pyrites which holds visible gold containing 15 to 20 per cent of silver!

I beg to state that I am not writing at all at random, as to this "novel freak of Nature," for I have within a yard of me, at this minute, a hundred or more specimens, of my own finding originally, which are undoubted proofs of sundry kinds of recent metal-growth. Possibly observed facts like these may, in part, be taken to explain how it is that what are called the "tailings" of some gold-mines, after a lapse of time, are found to contain actually more gold, on assay, than when previously assayed! More might be said on this head, and perhaps will be.

Some time in June last, when at Aberdeen, I drew the attention of Prof. Nicol to two gold specimens in the University Museum, which had propensities like specimens of my own which I had previously shown him. There were evidently recent *changes* in the *gold* of these two stones which nobody till then had observed. This opportune discovery, to my delight, half persuaded the esteemed Professor, I think, into favouring the "growth idea." A few days later I had the pleasure of a long talk about this and other things with Thomas Edward, in the funny little Museum at Banff. He has recently been entitled "*Observer*;" allow me to say here, by the way, that I found him *a very 'cute observer* then.

In conclusion, I may say that my present object is not to raise a tempest in a tea-pot about any name that anybody may call anything, anywhere. I merely put the mineralogical facts, and state my belief that the cabinet changes noticed above, and others analogous, are not such rarities as they are generally supposed. This opinion, doubtless, some of your readers already hold, and will presently be good enough to support by further examples. When I have more leisure I will give, briefly, a description of certain gold, silver, and other copper changes

(*growths*) which have come under my own observation.—I am, &c.,

T. A. READWIN.

Tulbrook, Liverpool,
March 29, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 11, March 12, 1877.

Influence of Pressure upon Chemical Phenomena.—M. Berthelot.—The development of hydrogen from the action of dilute acids upon zinc is not arrested by pressure, but merely slackened. The chemical affinity is not modified.

Metallic Iron found at Santa Catarina, in Brazil.—M. A. Damour.—The metal in question has the following composition:—

Iron	63·69
Nickel	33·97
Cobalt	1·48
Sulphur	0·16
Phosphorus	0·05
Carbon	0·20
Silicon	0·01
	99·56

The metal is therefore exceptionally rich in nickel, and presents certain characters, both chemical and mineralogical, which have not hitherto been met with in any meteoric iron of authentic origin.

Measurement of the Thermic Intensity of the Solar Radiations received on the Surface of the Soil.—M. A. Crova.—The calories received normally varied from 0 to 1·21 in fifteen hours of exposure to the sun. The heat normally received on January 4 is 0·61 of that received July 11, but on the surface of the ground it is merely 0·281.

Metals Accompanying Iron.—M. A. Terreil.—Reserved for insertion in full.

Chemical Examination of Mistletoe (*Viscum album*).—MM. H. Grandeau and A. Bouton.—Already noticed.

Acute Poisoning by Acetate of Copper.—MM. V. Feltz and E. Ritter.—The authors conclude that the acetate of copper is a more active poison than the sulphate, but that if mixed with foods or drinks in poisonous doses it imparts to them such a flavour that no one could possibly swallow them without being aware of the presence of the poison.

No. 12, March 19, 1877.

Decomposition of Binoxide of Barium in a Vacuum at the Temperature of Dark Redness.—M. Boussingault.—The author filled a tube of Bohemian glass with fragments of peroxide of barium: a vacuum is made with the mercurial Sprengel pump, and the tube is heated to dark redness. On continuing the action of the pump about 2 litres of oxygen were obtained; the volume which the binoxide used ought to appear. Some binoxide of barium was then placed in a tube, and the temperature was kept at dull redness for about two hours. There merely appeared a few bubbles of gas, due to the expansion of the gas remaining in the apparatus. On causing the mercurial pump to act oxygen was disengaged, on measuring which it appeared that the whole of the binoxide was decomposed. In another experiment the tube containing the binoxide was raised to a slight cherry red there was no escape of gas. A vacuum was made, and immediately oxygen was evolved more rapidly than at dull redness. A tube containing binoxide was heated to dull redness; on making the vacuum a current of oxygen was produced. The heat was then slackened, and in consequence of the cooling the oxygen which had escaped was promptly re-absorbed by the baryta, binoxide of barium being formed again. A vacuum was reproduced in the tube in consequence of this absorption. By thus varying the temperature of the tube the liberation or absorption of the oxygen may be alternately effected. Always after the dissociation effected between a dull and a cherry redness the baryta recovers all its properties, among others that of energetically absorbing oxygen.

Phosphorescence of Organic Bodies.—Dr. T. L. Phipson.—With refesence to a paper communicated by M. Radziszewski (*Comptes Rendus*, February 12, 1877) Dr. Phipson calls attention to his memoir on "Noctilucine, the Phosphorescent Principle of Luminous Animals," published in the CHEMICAL NEWS for 1875.

Singular Case of the Production of Heat.—M. J. Olivier.—A square rod of steel, 80 centimetres in length and 15 millimetres square, is grasped firmly by both the hands of the operator, one of the hands being placed in the middle of the rod, and the other at one end. The free extremity is strongly pressed against an emery wheel revolving very rapidly. After a few minutes the extremity thus rubbed becomes strongly heated: the hand placed in the middle of the bar does not experience any feeling of heat, but the one at the other extremity is heated to such an extent that the operator is compelled to let go.

Reform of Certain Analytical Processes used in the Laboratories of Agricultural and Meteorological Stations (Part I., Ammoniametry).—M. A. Houzeau.—Reserved for insertion in full.

Preparation of Crystalline Acetate of Magnesia, and on the Fermentation of this Salt.—M. L. Patrouillard.—The author has succeeded in obtaining magnesic acetate in crystals deliquescent in a moist air, but efflorescent in dry air. If the solution is placed in a wide vessel, and exposed to the air for some time, a kind of fermentation is set up, the products being carbonate and formiate of magnesia and wood-spirit.

Simple Method of Producing certain Bi- and Trichlorated Acids.—M. E. Demarcay.—The author makes use of the action of perchloride of phosphorus.

Transformation of Pyro-tartaric Acid into Dibromo-pyro-tartaric and Dibromo-succinic Acids.—MM. E. Reboul and E. Bourgoin.—Not adapted for abstraction.

Action of Chloro-chromic Acid upon Anthracen.—M. A. Haller.—Wishing to utilise the action of chloro-chromic acid, at once oxidising and chlorinising, the author caused it to act upon anthracen so as to obtain bichlorated anthracen, which, on treatment with potassa, should yield alizarin. 10 grms. of anthracen were dissolved in glacial acetic acid, and treated with 30 grms. of chloro-chromic acid freed from chlorine by a current of CO_2. The green liquid was poured into distilled water; the yellowish precipitate collected on a filter, washed, dried, and partly sublimed in a retort, and partly dissolved in alcohol. Both the sublimate and the matter obtained on crystallisation had the form of splendid needles, having all the properties of anthraquinon. They dissolved with a reddish yellow colouration in concentrated sulphuric acid. Water precipitates the bulk of the product from the solution. If melted with potassa they gave a violet mass, which on solution in water was partly decolourised, unaltered anthraquinon being precipitated. The potassic solution, acidulated with nitric acid, filtered, and treated with nitrate of silver, did not give a precipitate of chloride of silver. The product, therefore, contained no chlorine, and was pure anthraquinon.

Constitution of Pseudo-purpurin: Sequel of Researches on the Colouring Matters of Madder.—

A. Rosenstiehl.—Pseudo-purpurin, the most complicated of the colouring matters of madder, is so unstable as to produce by its partial destruction all the other madder colours except alizarin.

Biedermann's Central-Blatt für Agricultur Chemie, Heft 1, 1877.

Influence of Conifers in Comparison with other Trees upon the Temperature and the Amount of Ozone in the Atmosphere.—L. Fautrat.—Air above woods is cooler in summer and warmer in winter than air taken at the same elevation above the bare ground. Ozone is less abundant, especially over forests of coniferous trees.

Removal of Plant-Food by Rivers.—Prof. Harlacher and Dr. J. Breitenlohner.—An account of the fertilising matter carried away from Bohemia by the waters of the Elbe. The sewage of most of the riparian towns, especially Prague, flows directly into the river.

Contribution to the Knowledge of Arable Soils.—Dr. J. Hanamann and L. Kourimsky. –Proceedings of the chemico-agricultural Station at Lobositz, founded by Prince Schwarzenberg.

The "Peculiar Soil" of Hungary.—E. de Kvassay.—An account of certain soils rich in soda. Few plants flourish on these soils; the wheat is remarkably heavy; the grass, which consists almost exclusively of *Glyceria maritima*, fattens sheep very rapidly; and the plums, pears, and apricots are remarkably sweet. The trees, however, do not live long.

Chemical Analysis of Fossil Bones.—Prof. Krocker.—The bones in question are found at Olkusz, near the frontiers of Poland and Silesia. They contain in some cases as much as 74 per cent of calcic triphosphate, and are remarkably free from iron and alumina.

MISCELLANEOUS.

Appointment of Public Analyst.—Mr. A. H. Allen, F.C.S., &c., has been appointed Public Analyst for the West Riding at a salary of £250 per year, and 6s. for each analysis.

Qualitative Blowpipe Analysis.—The Council of the Society of Arts announce that they are prepared to offer Prizes of £5, £3, and £2 respectively, and Certificates, for Proficiency in Qualitative Blowpipe Analysis. The competition is open to any person, but as it is intended principally for those interested in the mining industries of Devon and Cornwall, the Examination will be held in the centre of the mining districts. The arrangements will be in the hands of a Committee of the Miners' Association, and intending candidates should apply to the Honorary Secretary of the Association, Mr. J. H. Collins, Lemon Street, Truro. The Examination will be held at Redruth, from 5 to 9 p.m., on Tuesday, 5th June, 1877, and will be conducted by Dr. Clement Le Neve Foster, H.M. Inspector of Metalliferous Mines. The Examination will be entirely practical, and the following will be the conditions.—1. No Prize or Certificate shall be given unless the candidate has taken a Certificate in the Science and Art Department Examinations in Inorganic Chemistry and Mineralogy. 2. The candidates will have to determine the composition of several minerals and simple artificial products, writing down each experiment, its result, and the inferences drawn from it. The examiner will have the right, during the practical examination, of putting questions to the candidates to test their ability. 3. Each candidate will have to bring his own blowpipe, lamp or candle, platinum forceps, reagents, platinum wire, charcoal, spirit lamp, glass tubes, &c., and any other blowpipe apparatus he likes. Any dry reagents may be used, but the only wet reagents allowed will be nitrate of cobalt and water. The use of gas and blowing machines will not be permitted. 4. If two or more competitors for prizes are equal, their respective merits will be decided by a second examination. 5. Persons who have not passed the Science and Art Department Examinations may present themselves for examination in Blowpipe Analysis, but they will not receive a Certificate until they satisfy Condition No. 1.

NOTES AND QUERIES.

Valuation of Sulphur Ores.—Can any of your readers tell me how sulphur ores are valued; I do not mean how the sulphur is estimated, but how it is valued when estimated?—CHEMICUS.

Chemical Schools in France.—Would any of your correspondents kindly give me the names of one or two of the principal "Schools or Colleges of Chemistry" in France?—CHEMICUS.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

FEBRUARY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·000	0·006	0·165	0·073	21·30	7·840	0·360	0·86	1·666	13·2	2·4
West Middlesex	Slightly turbid	0·000	0·007	0·180	0·077	20·70	8·960	0·360	0·86	1·600	12·6	3·8
Southwark and Vauxhall	Slightly turbid	0·001	0·007	0·180	0·077	20·60	8·790	0·360	0·86	1·633	13·2	3·8
Chelsea	Slightly turbid	0·000	0·006	0·180	0·066	21·30	8·680	0·396	0·86	1·700	13·2	3·3
Lambeth	Slightly turbid	0·000	0·008	0·210	0·056	21·60	8·960	0·432	1·01	2·166	13·2	4·2
Other Companies.												
Kent	Slightly turbid	0·000	0·003	0·390	0·001	28·60	11·760	0·504	1·51	4·000	18·8	6·0
New River	Slightly turbid	0·000	0·005	0·135	0·049	21·70	8·680	0·360	0·86	1·500	14·3	4·2
East London	Slightly turbid	0·000	0·007	0·180	0·063	19·80	9·128	0·432	1·01	2·266	15·4	4·2

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

THE CHEMICAL NEWS.

VOL. XXXV. No. 907.

THE NEW "PATENT" BILL.

THERE have been revolutionists who desired the equal distribution of land, and schemes of fraud and violence have in all nations had great success. There are some Governments who wait until individuals accumulate wealth, and then seize upon it by some pretext, whether directly or by increased imposts, or, as in smaller communities, by increase of rent; but it has been reserved for our age to raise up a class of men to prey upon the thoughts of inventors, and grip them as soon as they emerge from the dark recesses of the brain and are expressed in a form of speech or writing. These men of violence are also men of talent, and in an age of science they seek also to be scientific and hide their propensities in the words of apparently economic law.

The above reflection is one very simple result of considering opinions of late found floating regarding patents. We have been told that there can be no property in thought. We say that thought alone is real property, and it is with pleasure that we see a Government willing to watch over the interests of inventors, so as to induce them to give to the nation that valuable property which, if they please, no power can take from them, but which from its peculiar character cannot be used for their own benefit without the aid of the State, whilst, if once seen, it may be used by strangers and abundantly appropriated by the unscrupulous. It is proposed to extend patent rights from fourteen to twenty-one years. This change is in the right direction. We owe much to inventors: it is difficult to say how much of the superiority of which the nation boasts is due to invention, but it is a very large proportion. There are still many who tell us that our position is owing to our spirit or "pluck," and a clergyman once told us that the pluck was obtained by port wine. This is the way that even some educated men seek out the causes of things. There must be good roots and feeding to produce a fine tree; but a tree is known by its fruits, and our country is great by its invention. We live by the cunning of our right hands—the gift of a Providence which gave us also the crude material. There are some men who would assign as a cause of our position, physical strength and brute power of fighting; but what is a man before the engines of war? Men who attribute all success either to strength or to mere vigour of animal spirits, unreasoning and unsystematic, are like some ancient Celts who, on invading Italy, rushed on the armed Romans without clothes and without weapons. They were true believers in pluck, but it failed; and thus Rome lost some blood that would have made a good mixture. Others think we owe our superiority to land, although we buy food for some months of every year. Such men are like the coins we used not long ago, which asserted, in spite of facts, that the King of England was King of France. It is by invention, in a great measure, that we induce the world to send to us all its choice things. If there is any class of men which we ought to honour it is inventors, and yet we struggle about their rights in little bills that are humiliating in our opinion. A wider mind than usual has touched a key in this new proposal, but little men also have done their part; this appearance may be owing to its being an accumulation of Acts.

The Commissioners of Patents are to be numerous; six are named, and five more are to be named—all, we suppose, lawyers, as the six are: why so many, who can tell? But "the number of examiners shall be *two*, and the number of assistant examiners shall be *two* or more, not exceeding *four*." "They shall be specially qualified for the office by legal or scientific knowledge."

It appears, then, that of the *two* or *four*, or, adding them, six, one at least shall be legal, or may be legal. This would leave of scientific men only one, or five at most, perhaps fewer; it is not said how many are to be lawyers.

When a patent is filed it is first scrutinised by the examiner. There are about five thousand patents applied for annually, and the examiners must read them all. Let them work without rest for three hundred days in the year. The patents are to be examined again when the full specification is given in, after three months, and this must be compared with the provisional. There are, then, ten thousand specifications to examine and to report upon, and each report is to be of value. We have, then, thirty-three patents daily, or six patents to each. For each patent one man at least has toiled long and spent money; for some it is the end of years of toil: but now a stranger must give his opinion on six daily,—a little more than an hour to the whole labour of a patent,—writing also a report upon it that will bear examination in a Court. But we doubt if this is judging fairly. There are to be only *two* examiners, and it is to be supposed that each patent shall pass examination by one of them, and, although assisted, the meaning must pass through his brain. If not, then the assistant examiners become true examiners, and not assistants. With this more correct reasoning an examiner must pass at least sixteen specifications in a day, which, with all the aid of assistants who may have had half an hour longer to examine them, is a task inconceivable. Surely the scientific man is expected to do wonders. We have heard a whole court and many lawyers arguing about a patent for days, whilst the arrangements occupied months. No wonder that the scientific man may now be asked, as in Clause 46, to assist the Judge. It does at least show the advance of scientific influence—an advance made absolutely necessary and long struggled against. But it may be asked, how many examiners should we recommend? We cannot tell. If the system is to be carried out, there must be enough to do the work. Clerks in any number may be appointed, but no assistance will enable the examiners to pass through their brains, in a profitable manner, the number of inventions demanding protection, or we must greatly over-rate invention and under-rate the power of the examiners.

There is another question—What is a scientific man? It would seem as if he were spoken of as a man knowing all science. There must be some one or more with a minute amount of mechanical knowledge. There must be one or more with an equally minute amount of knowledge in chemical manufactures; but there are various departments of mechanics, and so of chemistry, and pure scientific knowledge will by no means be enough. Besides these there are other departments, and some strange outlying districts of knowledge. But perhaps we are wrong. In Clause 51 the Commissioners are given power to appoint as many officers as they think fit, notwithstanding the precise clause regarding examiners and assistant examiners. Perhaps this is one of the modes of evading the prior clauses, but we should much prefer the removal of these apparently contradictory or impracticable clauses.

We have been spending some sympathy on these examiners as being overworked, but in Clause 52 we find that the Commissioners may set them to arrange, index, and abridge the specifications. Is this to be done after their work? This of course shows that the whole has not been considered by any one who has been fully made aware of the difficulty, or else the meaning of the terms is not such as we understand. We write under fear that we do not fully understand the phraseology, and may be doing or thinking unjustly.

In 62 we observe a peculiarly objectionable addition, and apparently without the smallest use. The extended time is not to apply to patents unless taken out after the

passing of this law. What quality can be found in patents after the law that ought to exclude others? We hope that this narrow feeling will be hidden from view.

As to the prices, it has been shown that the country gains so much from patents that it would be well not to ask too much for the so-called privilege. Patents have gained wealth, and must not pay for the permission to make the country rich: they ought only to pay, as it were, a police for their protection. It would be nobler when extending the time not to extend the price. £110 are wanted for renewal, and patent agents will require an addition. It is a large sum to many a poor patentee—a small sum to a few only. We should be glad to see the sum reduced to £50 every five years—not a great reduction, but a uniform charge and abundantly high—the first £50 to be paid in the sixth year.

The amount of fees to be paid for the patent when granted justifies the expectation that the work will not be done in a slovenly manner, and even if not granted the amount to be paid is sufficient.

The full specification is to be filed three months after the provisional, instead of at present six. We see no good reason for restricting the time and privilege of the patentee in this case, and would prefer not to meddle with the time now allowed.

Although the time of application is fixed, the time for giving a report on the patent is left very open, and we are informed in Clause 8 that "The use and publication of the invention after the application and within a period of *twelve* months from the date of the application shall not prejudice the grant of a patent for the invention." This seems to look to a very long delay in reporting; and when we consider the few scientific men employed, and the large number of legal authorities, we have two sufficient reasons. It will certainly be a painful thing for an inventor to wait so long, and still more painful should he be told, after using his invention for a year, that it is not his. We must therefore conclude that the machinery for reporting is insufficient, if we understand it properly.

The question may be asked whether the principle is correct. On this point we have a decided opinion, we believe it to be right to scrutinise patents; but whether there are human beings yet created wise enough to carry it out well enough in England is not known to us, but we certainly think that it is well to try. We can point to conspicuous failures in the plan, and we can point to that which, in the opinion of many, is a success.

The right of the Government to use a patent on its own terms seems arbitrary, but perhaps unavoidable.

The demand that a patentee shall make efforts to have his patent used is severe. Why should an inventor have laid upon him the trouble of treating with others to have his plans adopted? This is a labour for which the inventor is often quite unfitted and eminently unfitted. The only fair demand made upon him in this respect seems to us to be that he should give licenses when required in a reasonable manner, and this is a very important improvement.

We have mentioned some points that are decidedly against the Bill, but these can be amended, and, indeed, must be. Gradually our legislators will learn the importance of patents, and still further advances may be made in future. There has been a difficulty in the minds of some persons as to the rights of inventors as compared with writers. The principle must be the same—the protection of wealth made by the brain. The different quality of the products decides a difference in treatment. If we buy a copyright book we pay the writer through the publisher, or we hope to do so, and an inventor must have a manufacturer or publisher for his invention, keeping or selling the copyright. The difficulty in the case of the discoverer is not one of principle. He deserves a protection for the wealth of his mind, but we have not ye fully discovered the best mode of giving it. When peopl use his ideas and honour him, he receives part of hi reward, sometimes all he desires, and we have an opinion that discovery is so noble that it is scarcely possible to give an equivalent. Who can tell the value of a law of nature, and what shall we pay for it? We give love and honour, and we like to see the discoverer above the evils of poverty; but we have not yet learned to give him his due position, and we shall never be able to fix his due payments. We leave the subject amongst sacred things at present.

Some people imagine that patents are a voluntary boon, a gracious gift to inventors. It is otherwise; inventors endow the nation with their inventions, and are allowed by means of patents that protection which property must have in order to prosper. There are men who argue as to the rights of inventors; but who can decide about the rights of man? Many subtle questions arise in such a discussion. Others, again, say that patents are given, not as a right but as a matter of expediency. The rights of inventors are like those of the Emperor of Russia—right or wrong you cannot remove them; they are like those of the possessors of the soil by legitimate inheritance; but, in addition, inventors have a right exactly akin to that which a man has to his own life, and which it is the bounden duty of a Government to protect. The use of the law is to protect our bodies, and we must add also to protect our minds, our freedom of thought, our right to the wealth of our brains as well as of our hands. Besides this the inventor has a still higher right, that of keeping all to himself and telling no one, and this right we know he exercises when not well dealt with.

Let us be thankful that there are men who invent. We know of places with too much law; we know of none with too much invention. Let us foster that which needs fostering. In principle we are pleased with the Bill because it allows a certain position to science hitherto denied, and certain rights to inventors above those recognised; but we have a little laugh when we look at the modest way in which these great powers are allowed to stand in the face of high society. We may make some curious comparisons, and one that suits the time is the slow progress of relief given to the Jews, until now all nations seek their help, and one stands at the head of our affairs, and has affected lately the destinies of Europe and the world. Science and invention are not smaller, and they will grow.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

I. GALLIUM has been too recently discovered for its study to be very advanced at present. By reason of the great scarcity of the new element in the ores at present examined, the time which has elapsed since its discovery has been principally devoted, first, to the search for a practical method of extraction; then to the treatment (always a long process in a small laboratory) of several hundreds of kilogrammes of ore; lastly, to its purification, necessarily very complicated, on account of our ignorance of the way in which gallium behaves itself with many reagents.

I am therefore able to give only a very incomplete history of gallium. This sketch will, nevertheless, I hope, be sufficient to serve as a basis for the researches which other chemists will perhaps undertake.

II. *Historical.*—Since I have been occupied with chemistry my attention has always been directed to the question of the classification of the elements. Interesting relations had already been noticed by several *savants* (particularly by M. Dumas) between the atomic weights of certain simple bodies, and the properties which have led chemists to group those bodies into one natural family. I applied myself to the task of discovering new relations, either by comparison of the atomic weights of the elements, or by that of their qualities: such, for example, as the emission at a high temperature of luminous rays of deter-

* Communicated by the Author.

mined wave-lengths. I thus discovered some relations hitherto unknown, and I drew from them some novel deductions.

The substance of these ideas was deposited with the Secretary of the Institute in sealed packets, and I had the honour of explaining my ideas somewhat more in detail before some illustrious chemists, principally in conversation with MM. Dumas and Friedel.

Amongst the conclusions that might be drawn from my attempts at chemical classification was the probability of the existence of unknown elements coming to fill up the gaps left vacant in the natural series. It is clear that the position thus occupied in a chemical family by a hypothetical body indicates approximately the properties of that body.

However, speculations of this kind are always attended with a certain amount of indecision. Thus, notwithstanding the importance which I could not help attaching to the hypotheses born of my imagination, I did not think it right to publish them without their having been first submitted to experimental proof, and without having made strenuous efforts to obtain from them positive results for their confirmation and further development.

The present perfection of chemical analysis, and the care with which nearly all the known minerals have been examined, leave little hope of finding new elements; we can only expect to meet with them as minute traces disseminated in considerable masses of foreign substances.

The uncertainty which inevitably prevails in the exact chemical reactions of a hypothetical body, defined by its individual position in a natural series, renders a success founded solely on the direct application of those reactions *calculated beforehand* rather problematical, for the slightest error in the conjecture of one of them may drive the body sought for out of the analytical place which theory assigns to it. This difficulty seemed to me very great, and to obviate it I invented a particular method of mineral analysis, so that an error bearing either on the properties of the bodies sought for, or on those of the known elements, would not interfere with the final issue.

By reason of its extreme sensibility, spectrum analysis is a great assistance in this kind of work; but it does not constitute an essential and indispensable part of my method of research. It is, however, a marvellous instrument, whose power must be utilised, and to the successful application of which I formerly devoted several years. I believe that the spectral examination of so small a quantity of liquid as that by which I proved for the first time the existence of gallium would have been impracticable before the considerable modifications to which I submitted the apparatus for obtaining electric spectra. My designs, carried out *under well-determined experimental conditions*, were equally indispensable to guide me amongst the numerous rays which the metallic spectra contains.

My first attempt at research for new elementary bodies was made fifteen years ago. At that time I possessed no laboratory, and the instruments at my disposal were quite inadequate. This attempt, which was made with a considerable amount of material, had to be abandoned before it was finished, and the greater part of the results obtained were lost. In 1863 I built my present laboratory, and furnished it with more complete apparatus. I renewed my attempts, and made several series of researches, but without any success; I evidently employed too small a quantity of material. These experiments were not, however, entirely useless, for they gave me an opportunity of perfecting the method on which I am continuing to work, in the hope of one day publishing it.

At last I decided to operate on a larger scale, as I had done at first, and in February, 1874, I began the treatment of 52 kilogrms. of blende of Pierrefitte, obtained for that purpose in the autumn of 1868.

On the 27th August, 1875, between 3 and 4 o'clock in the afternoon, I perceived the first indications of the existence of a new element, which I called "Gallium" in honour of France (Gallia).

Guided by certain considerations, I anticipated a little, I must confess, on the rigorous course of my methodical analysis, I then treated, preliminarily, on the 27th August, a portion of a white deposit which began to form in one of my products in contact with plates of zinc. This deposit was dissolved in hydrochloric acid, and the solution precipitated by ammonia in excess. It was then filtered, evaporated, and the ammoniacal salts destroyed by boiling with aqua regia. The liquid thus obtained, submitted to the action of the electric spark, showed in the spectroscope, besides many known rays, a very faint trace of a violet ray, situated towards 417 on the scale of wave-lengths.

This ray not existing in any of my drawings of spectra, I had no doubt that I was dealing with a new element, and I immediately proceeded to augment my supply of precious material.

I estimate that the quantity of gallium in the little drop of liquid examined at my first observation did not exceed 1-100th of a milligrm. The whole of the white precipitate which was already formed was immediately dissolved in hydrochloric acid, and treated in the manner previously stated. The resulting acid liquor was saturated with sulphuretted hydrogen, filtered, then submitted again to the action of sulphuretted hydrogen, after having added an excess of acid acetate of ammonia. A sulphide of zinc was separated,* which, dissolved in hydrochloric acid, gave clearly in the spectroscope the ray 417 and another violet ray, more feeble, situated towards 403 on the scale of wave-lengths. Subsequent observations proved that this ray 403 belongs also to gallium.

Thanks to these first experiments, I had then, from the night of the 27th to 28th August, proved beyond doubt the existence of a new body; but I had only obtained a small quantity of it, estimated at one-tenth of a milligrm., and containing many impurities. I, however, made use of it to study, as well as I was able, some fundamental reactions which I described in a sealed packet addressed to the Académie des Sciences on August 29th (opened the 20th September, 1875).

A few days after the hydrochloric solution of the gallium sulphide of zinc was precipitated by carbonate of barytes; the precipitate was then washed, and treated with a mixture of hydrochloric and sulphuric acids. The resulting salt showed, besides the zinc spectrum, the rays 417 and 403 already well marked.

During this preliminary examination of the compounds of gallium my general analysis was being actively carried on. At the end of three weeks I had succeeded in acquiring about 2 or 3 milligrms. of gallium chloride still mixed with chloride of zinc. I then went to Paris, where, in the last week of September, 1875, I had the honour of conducting before the Chemical Section of the Institute a course of experiments demonstrating the individuality of gallium.

I would here remark that if I had not anticipated the results of my method of analysis the discovery of gallium would perhaps have been a few weeks later, but the conditions would have been such that its existence could not have escaped the notice of the merest tyro in spectrum analysis. In fact, except the previous treatment of a part of the white precipitate formed by zinc in one of my products, the execution of the plan *marked out beforehand* was as rigorously pursued as if I had been ignorant of the presence of the new element. I thus succeeded in obtaining with a few drops of the solution the two gallium rays, no longer in scarcely perceptible traces, but extremely bright, far more brilliant indeed than any of the other metallic rays present.

It will be seen, then, that, possessing as I did exact drawings of the spectra furnished by all the known elements, gallium would have been discovered, in the absence of all preconceived ideas, by the simple application of the analytical method that I followed.

It now became necessary to increase the quantity o

* The white precipitate formed by contact with metallic zinc contained sub-salts of zinc.

material for study. Thinking it probable that the Pierrefitte blende was not the most advantageous mineral for the extraction of gallium, I tried a large number of blendes and products of zinc works. I succeeded, however, in finding only two richer than Pierrefitte blende; these were the yellow transparent blende from Asturias and the black blende from Bensberg. All the other substances I examined were much too poor.

Thanks to the kindness of the mining companies of Vieille Montagne, of Nouvelle Montagne, and of Corphalie; of my friend, M. Friedel, and especially of M. Malgor, the engineer of the mines of Pierrefitte for the Asturian Company, I obtained considerable quantities of ores, which were treated, not by my general method of research, but directly for gallium. My acknowledgments are also due to M. Wurtz for the liberality with which he opened his laboratory to me during my stay in Paris, and for the trouble he took in bringing me into communication with several directors of manufactories who have kindly sent me materials which have been most useful in my experiments.

Before beginning to operate on several hundreds of kilogrammes of ores it was necessary to find a quicker and less expensive method of extraction than that employed to isolate the first milligrammes of gallium salts.

During the crushing of the ores and their treatment with over 1500 litres of aqua regia, I continued the examination of the chemical properties of gallium by utilising the few milligrammes of chloride produced from the first sample of Pierrefitte blende; it was with this product that the ammonia-gallic alum and the solid metallic gallium presented to the Académie des Sciences on the 6th of December, 1875, were prepared, and also the *liquid* gallium, described in the sealed packet received by the Academy on the 6th of March, 1876, and opened on the 1st of May.

The relatively large quantities of gallium extracted from the products of my grand operation enabled me to verify the facts formerly observed, and to determine some other properties, such as its density, fusing-point, &c.

Gallium was reduced to the metallic state for the first time in November, 1875, by the electrolysis of an ammoniacal solution of its sulphate. The metal was deposited on a sheet of platinum serving as a negative electrode; the positive electrode was at the same time covered with a whitish film, formed by a pellicle that was easily detached from the platinum, insoluble in a large excess of ammonia, but easily soluble in hydrochloric acid.

In this first experiment 1·6 milligrammes of gallium were deposited in four and a half hours on a platinum foil of about 185 square m.m. surface; the surface of the positive electrode was 877 square m.m. The battery was composed of five bichromate pairs (zincs = 17 × 10 c.m.) connected for tension. In order to avoid any mistake as to the nature of the reduced metal it was dissolved in hydrochloricacid; the solution gave a beautiful electric spectrum of gallium, but also, though very faintly, zinc rays and minute traces of other rays.* The metal obtained then was gallium, but containing a small proportion of zinc.†

A second sample of gallium prepared under the same experimental conditions as the former was laid before the Academy on the 6th of December, 1875; it weighed 3·4 milligrammes, and was deposited in five hours forty minutes upon a surface of about 123 to 124 square m.m.; the positive electrode was furnished by ten bichromate pairs (zincs = 17 × 10 c.m.) connected for tension.

These two specimens of gallium presented all the chemical properties of pure gallium, but the physical aspect was quite different. They were presented in the form of a solid layer adhering to the platinum and polishing badly when rubbed with an agate burnisher, but better when strong pressure with the same burnisher is used, the metal being brittle and a little whiter than platinum.

When the electric current was duly regulated together with the relative dimensions of the electrodes gallium assumed a beautiful silvery appearance; at the end of the operation the surface was finely granulated, and scattered over with brilliant points, which the microscope showed to be crystals; there were here and there some points, larger and more brilliant than the others, which had quite the appearance of little craters, the sides of which were covered with crystals.

The time required for the electrolysis of the ammoniacal solution of gallium was very long for the small quantity of metal obtained; I therefore employed caustic potassa, which dissolves a large quantity of oxide of gallium and forms a solution which readily undergoes electrolysis. This experiment I performed in February, 1876, when I only disposed of a few milligrammes of substance which had escaped previous electrolysis. I was astonished to find that the gallium was separated from the caustic potassa solution in the form of a dull greyish white coating, composed of innumerable small *liquid* globules. I immediately divided the metal (there was about a milligramme of it) into several portions to be submitted to separate experimental trials. It was thus demonstrated: 1st. That this liquid gallium possessed the same chemical properties as the solid gallium of the earlier preparations. 2nd. That it did not contain mercury, its hydrochloric solution not being coloured by iodide of potassium, ammonia, or hydrosulphate of ammonia, nor did the metal volatilise at red heat. Spectral examination showed that liquid gallium was purer and contained less zinc than solid gallium produced by ammoniacal solutions.

A very small globule exposed for several weeks on a plate of glass to the open air of the laboratory did not lose its liquidity and preserved its metallic lustre. It was, however, divided every day, then re-united by means of a fine steel point, and the surrounding temperature lowered almost to zero if not rather below it. The liquidity of this gallium can scarcely be attributed to the presence of potassium reduced by the voltaic current, for the alkaline metal would then have been quickly oxidised both during the washings and by contact with moist air.

In the sealed packet received by the Academy on the 6th of March, 1876 (opened on the 1st of May), I expressed my belief in the probable liquidity of pure gallium, attributing the solidity of the first specimens to the large proportions of foreign metals they contained. I also said that we might still suppose that by the electrolysis of the ammoniacal solution there is deposited, not pure gallium, but a compound of that metal with the elements of ammonia (hydride, amidide, nitride). That was not impossible, but seemed scarcely probable. Having, towards the end of April, 1876, prepared 10 centigrms. of gallium, which I had reason to believe was very pure, it became easy for me to explain the singular facts I had noticed in the specimens which had served for my earlier researches.

I have recently re-united and treated all the gallium products in my possession, and I have obtained from them 65 c.c. of pure gallium. A few decigrammes are still disseminated in different residues. I do not think, however, that the whole quantity extractible (including the 65 centigrms.) exceeds or even reaches 1 grm. Such is the yield of about 430 kilogrms.* of raw material, some of which, it is true, was extremely poor. With 430 kilogrms. of Bensberg blende several grammes of purified gallium would evidently be obtained.

(To be continued.)

* The zinc rays were rather more marked in the spectrum from the hydrochloric solution of metallic gallium than in that from the material which had served for that preparation. This may be readily imagined, since ammoniacal solutions of zinc are very easily reduced by the voltaic current. The zinc ought then to accumulate in the first metal deposited, which is precisely what occurs. The oxide of gallium that remained in the solution, or that was precipitated in an incluble state during the operation, had been in part deprived of zinc by the electrolysis itself.

† The spectral reaction of chloride of iron not being very sensible it is possible that a certain quantity of iron might have been contained in the first specimen of gallium.

* The 120 or 130 kilogrms. of laminated zinc employed as a reagent are not included in the 430 kilogrms. This zinc, indeed, seems to be almost entirely free from gallium.

ANALYSIS OF CHROME IRON AND STEEL.

By WILLIAM GALBRAITH, F.C.S.

Having for some time had occasion to make frequent analyses of chrome iron and steel, I found there were a number of difficulties presented themselves, and, as it was a matter of importance to return the analyses in a short space of time, it became necessary to devise some means of quickly determining the percentage of chromium, &c.

The first difficulty I found in analysing the chrome iron, or chromium as it is called, was the fact of its insolubility in the usual reagents used in the analysis of irons. Nitric acid will not dissolve it nor hydrochloric acid, but nitro-hydrochloric acid will dissolve it in time; *i.e.*, if the chromium is as high as 10 per cent it may take four or five days' boiling before it is dissolved. I found, however, that the best solvent was dilute sulphuric acid, in which it dissolves very rapidly; and here I may say that a writer in a late number of the Chemical News describes a process of determining the chromium, in which he pays not the slightest attention to the fact of its insolubility, commencing the description of his process after it is in solution.

The method I have adopted for the determination of the chromium is as follows:—

1 grm. of the chrome iron is dissolved in dilute sulphuric acid (about 6 parts of water to 1 of acid). Sufficient potassium permanganate to oxidise all the iron is now added, and then about as much more, and the solution boiled until the colour of the permanganate is destroyed. If there is a large excess of the permanganate it will of course take some time, which can be hastened by the addition of a little more sulphuric acid. I may say that I use the crystals of potassium permanganate, and that it is necessary to have the excess of permanganate, otherwise some of the chromium may escape oxidation, especially if there is much chromium. The black or dark brown precipitate, consisting probably of a mixture of permanganate and oxide of manganese is now filtered, washed well with hot water, and to the filtrate, which should of course be of a bright yellow colour, is added a known weight of ferrous sulphate, or preferably ammonio-ferrous sulphate, and the excess of iron determined with a standard solution of potassium bichromate.

This method I have found to give very accurate results, and as it does not occupy much time (not more than half an hour) it leaves little to be desired.

Steels of course are done in precisely the same manner, with the exception that 2 or 3 grms. of the sample are taken instead of 1. The following are a few examples of my test experiments:—

	Chrome Iron.		Steel.		
	1st.	2nd.	1st.	2nd.	
Chromium ..	6·88	6·79	0·85	0·83	per cent.
			0·46	0·45	,,

Another test experiment was made by adding 10 c.c. standard potassium bichromate to a sulphuric acid solution of ferrous sulphate, then adding permanganate, and proceeding as above. Thus, 1 grm. ferrous sulphate took 19·3 c.c.; by using 10 c.c., 10·0 c.c.; and proceeding as above 1 grm. took 9·3 c.c.

Carbon.—This I have done in the irons by the sulphate of copper process, and burning the carbon and copper together in oxide of copper, with the aid of a current of oxygen, and, although a little of the chromium is left with the copper, it does not interfere with the accuracy of the process.

I may note rather a curious fact here, that while the iron readily replaces the copper in the case of chrome irons, it refuses to do so in the case of chrome steels, the steel being only coated with copper, and remaining so for weeks. I have also made some estimations of carbon in the irons by combustion with lead chromate and potassium chlorate, which agree very closely with those made as above; but it is evident this is not a useful process for steels, as it is not easy to get steel into fine enough powder. Probably Weyl's galvanic process gives the best results.

Silica, Sulphur, Phosphorus, &c.—These can all be determined as usual in the steel, and with regard to their determination in chrome irons I hope to be able to make it the subject of a future communication.

Sheffield, April 4, 1877.

SCOTTISH TRIPOLITE.

By W. M. PATERSON.

In the autumn of last year I received a sample of what was supposed, by the friend who gave it me, to be a sample of clay. I happened by chance to examine it under the microscope recently, and was surprised to find that it consisted almost entirely of fossil or sub-fossil diatomaceæ. The sample received is of a greyish white colour, and remarkable on account of its extreme lightness.

On being calcined the colour, evidently due to a trace of organic matter, disappears, leaving behind a powder of the purest white. A portion of the calcined on being submitted to analysis gave the following result:—

Silica	95·66
Alumina..	3·08
Oxide of iron..	trace
Lime	0·28
Further loss on ignition ..	1·25
	100·27

The sample contained little sand, and readily dissolved to the extent of 92·4 per cent in solution of potassium hydrate.

From the above analysis it will be seen that this deposit varies considerably from the celebrated Barbadoes tripolite, or that from Sweden, the former containing 10 per cent of calcium carbonate, and the latter 6 per cent (analysed by Dr. Phipson, *vide* Chemical News, vol. xxxiv., p. 108).

Its composition agrees very closely, however, with that from the Puy de Dôme, France, which was found by Fournier to contain:—

Silica	87·2
Alumina and oxide of iron ..	2·8
Water	10·0
	100·0

If the above were calcined it would be composed as follows, agreeing pretty closely with the Scotch sample:—

Silica	97·0
Alumina and oxide of iron ..	3·0
	100·0

The diatoms are finely preserved, the valves belonging chiefly to the elongated type; but there are a great many of a very small round species difficult to resolve. One of the best is *Pinnularia dactylus*; *Surrirela eraticula* is also very abundant. Figures of these species with others which occur may be seen on page 342 of the last edition of Dr. Carpenter's work on the "Microscope," in which a woodcut is given of a very similar diatomaceous deposit from Mourn Mountain, Ireland.

The deposit from which the above sample was taken occurs on Ciste Mairearad, one of the highest of the Grampians, on the Glen Feshie side, Inverness-shire, on the estate of Sir George Macpherson Grant, of Ballin-

dalloch and Invereshie. The deposit is of unknown extent, but the sample was taken from a spot where about an acre of it is exposed, varying from 1 to 4 feet in depth, containing no stones or gravel, and very little sand.

It is not used for any purpose in the neighbourhood; the fact of there being no vegetable growth upon it, and its remarkable lightness having attracted the notice of my friend Mr. Duncan Clark, of Auchlean, Glen Feshie, to whom I am indebted for samples of it.

I hope shortly to be able to get more information concerning this deposit.

Loftus Iron Company, Saltburn-by-the-Sea,
March 29, 1877.

TITRATION OF A MIXTURE OF ALKALINE AND OF ALKALINO-EARTHY SULPHATES.

By MM. FERD. JEAN and H. PELLET.

LET there be a mixture formed of sulphates of potassa, soda, lime, magnesia, and of alkaline and alkalino-earthy chlorides and nitrates; it is required to determine the sulphuric acid combined with alkalies and the sulphates of lime and magnesia. These determinations may be easily and exactly obtained by the use of two standard liquids, the one of sulphuric acid the other carbonate of soda, by operating in the following manner:—

1. *Titration of Sulphuric Acid Combined with Alkalies.*—The matter being dissolved in water (or in water acidulated with hydrochloric acid, if necessary) is exactly neutralised with soda in a diluted solution. To a volume of the liquid to be analysed we add a slight excess of baryta water, then seltz water, and boil it to drive away completely the excess of carbonic acid, and to render insoluble all the carbonate of baryta. We filter, and pour into the clear liquid, coloured with a few drops of tincture of litmus, standard sulphuric acid to neutralisation. The quantity of sulphuric acid employed to saturate the alkali is exactly the same as that which was originally combined with the alkalies, potash and soda.

2. *Titration of Sulphate of Lime.*—A volume of the saline solution is mixed with alcohol; the sulphate of lime precipitated is collected on a filter, washed with alcoholic water, then introduced into a Bohemian glass, or into a capsule, with a known volume of a standard solution of carbonate of soda. We raise it to a boil, then separate by filtration the carbonate of lime arising from the decomposition of the sulphate. In the filtered liquid we titrate the carbonate of soda remaining, and we have by the difference the quantity of this salt passed into the state of sulphate of soda, which is calculated as sulphate of lime.

3. *Titration of Sulphate of Magnesia.*—The solution to be analysed is treated at a boil with a known volume of a standard solution of carbonate of soda; we separate by filtration the carbonate of lime and magnesia, and we determine in the filtered liquid by the aid of standard sulphuric acid the quantity of soda not decomposed, whence we calculate the amount of sulphuric acid belonging to the sulphate of lime and magnesia. The weight of the sulphate of lime being given by the preceding operation, we find by the difference that of sulphate of magnesia.

4. *Determination of Total Sulphuric Acid.*—If in a mixture of salts we wish to titrate total sulphuric acid, free and combined, we boil the solutions with carbonate of soda, we separate the carbonates of magnesia and lime, and the liquid, filtered after having been exactly neutralised with standard sulphuric acid, is treated with baryta water, as in the titration of alkaline sulphates. This method of titration gives very exact results when we employ a solution of sulphuric acid sufficiently dilute; thus, in a mixture of salts containing total sulphuric acid 0·664 gr., we have found by our process 0·663 gr., and in 0·112 of sulphate of potash 0·110 gr.

5. *Titration of Iron Pyrites.*—We have applied this process of the titration of alkaline sulphates to the assay of pyrites. 1 grm. of the ore to be assayed is intimately mixed with about 5 parts of pure carbonate of soda, 7 parts of nitrate of potash, and 5 parts of chloride of sodium; this mixture is raised to redness in a crucible. The mass is then exhausted with boiling water, the insoluble part is separated by filtration, and after having neutralised the solution with dilute hydrochloric acid, we titrate the sulphuric acid which has passed in a state of alkaline sulphate by means of baryta water and according to the indications given above. In a pyrites containing 37·4 per cent of sulphur (weighed as sulphate of baryta) we found, by our process 34 per cent.—*Bulletin de la Soc. Chimique de Paris.*

[A process which falls short of the truth by 3½ per cent is utterly worthless from a technological point of view.—*Ed.* C.N.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 5, 1877.

Professor ODLING, F.R.S., Vice-President, in the Chair.

AFTER the announcement of visitors, the minutes of the previous, the anniversary, and the extraordinary general meetings were read and confirmed. The names of the following candidates for election to the Fellowship of the Society were read for the first time:—H. R. Hind, A. Watt, G. A. Milne, and Dr. A. E. M. Franchimont.

A lecture "*On the Discrimination of Crystals by their Optical Characters*" was then delivered by Professor N. S. MASKELYNE, F.R.S., as follows:—The methods of investigation, the description of which is the purpose of the discourse, are, in their more practical aspect, *qualitative* methods. The practical application of them being that of determining the kind of symmetry which a crystal obeys, *i.e.*, the system to which it belongs. An attempt is being made, by the introduction of *quantitative* measurements into these methods, to get some insight into the nature of molecular structure. Thus far the physical and morphological properties of crystals have not been brought into very distinct correlation, and if, as is probable, the *intro*-molecular co-ordination of atoms and of groups of atoms within the unit molecule of the crystal may have to be invoked to unravel what a purely symmetrical *inter*-molecular distribution of the centres of mass of the unit molecules themselves may not be competent to explain, the result cannot fail to be of interest to the chemist, to whom the function discharged by special atom-groups in his compound molecules is becoming every day a more important question.

Reverting, however, to the practical side of the methods to be discussed, it will be seen that by a judicious use of the aid which polarised light affords, the chemist who is continually forming crystals of new and remarkable substances will be enabled to obtain rapidly valuable information about these crystals without having previously to become an adept in crystallography. The different systems of crystallography are distinguished by the character of their symmetries. For the purposes of optical comparison, as a cubical crystal acts on light as an isotropic body, we may omit the *cubical* system. The *tetragonal* and *hexagonal* systems may be grouped together. The *prismatic* or orthorhombic, the *oblique* or clinorhombic, and the *anorthic* systems will be treated of separately. The *orthorhombic* system, which may be termed the ortho-symmetrical system, has three [illegible]

dicular planes of symmetry, which are not congruent, *i.e.*, with respect to which the morphological and physical characters are dissimilarly distributed. The perpendicular axes in which these three planes intersect are the morphological axes of the crystal, and are coincident in direction with the three principal axes of the ellipsoids, which represent optical, thermic, or magnetic properties. The *oblique* or mono-symmetric system has a single plane of symmetry; its normal is one of the axes of the different ellipsoids which represent physical characters, and it is also that crystallographic axis which is perpendicular to the other two. The *anorthic* or centrosymmetrical system presents the smallest amount of symmetry possible, viz., that to a centre. The repetition of any morphological element is therefore simply that of the feature presenting itself on opposite sides of the crystal.

The influence of the crystalline arrangement of the ponderable matter upon the luminiferous ether results in the elasticity of this medium varying in different directions, or in its degree of condensation being different, or in both; and it also results that the directions of elastic strain and stress only act upon the same line when that line is parallel to one of the three perpendicular directions which are called the axes of optical elasticity. While in ordinary media the direction of a ray is normal to the tangent to the front of the wave, to which the ray belongs, in the general case within the crystal the ray is oblique to the wave normal. The cases in which it is not so being those of the axes of elasticity, and certain other exceptional directions of the optic axes. As the result of the peculiar distribution of optical strains in a crystal, an ideal wave of light would, in the general case, move forward with two velocities, and would present two wave fronts, one lagging behind the other. If we consider the path of a ray belonging to any point of one of these wave fronts it will be seen that it must have bifurcated, one branch of it meeting the other wave surface; but the normals to the wave surface at the two corresponding points are connected by the fact of their being parallel to each other. The swings of the vibrations at these two points are perpendicular to each other and to the wave normal. Wire models were exhibited, in which the intersections of this wave surface with the principal sections (*i.e.*, with the intersecting planes perpendicular to each axis) were seen to compose in two cases a kind of ring, formed by a concentric circle and ellipse; in the third case the figure produced was that formed by the intersection of a circle and an ellipse, the principal axes of the ellipse being in the ratios of the greatest and of the least, while the radius of the circle represented the intermediate parameter of the three velocities along the several axes. A tangent drawn to the circle and ellipse near their point of intersection meets in the case of the circle a ray, which is coincident with the wave-normal, and the lip or margin of a conoidal depression in this part of the wave-surface is circular in form, and touched by the same tangent plane which contains the tangent to the circle and ellipse. To every point of this circle there belongs a portion of a ray, and if a section be cut in a crystal parallel to this tangent plane, these rays will emerge with a common wave front, the normal of which will now be coincident with the rays as they emerge into an isotropic medium, while the oscillations are performed in the case of each ray in a plane passing through the wave-normal and the centre of the margin circle. The light thus emerging has therefore lost its polarised character, and the direction of the wave-normal is a primary optic axis of the crystal. The radius of the circle at the point of intersection with the ellipse, where the two figures have a ray in common, is a secondary optic axis. From the symmetry of the figures there are two primary axes, differing in the angles which they enclose, according to the ratios of the three constants representing the velocities along the three axes. These three axes will now be called the two mean lines and the normal. The *first mean line* bisects the acute angle between the optic axes, the *second mean line* bisects the obtuse angle, the *normal line* is that axis which is perpendicular to the other two. The orientation of the mean lines, *i.e.*, their relative situations in parallelism to one or another crystallographic axis is the first problem in the study of the optical characters in a crystal. Next we have to determine the angle between the optic axes, and here the dispersion, *i.e.*, the difference of angle for different colours, has to be taken into account. In connection with the first of these problems we have to contemplate the cases in which the angle between the optic axes becomes *nil*; the axes themselves coinciding with the first mean line. Let, for instance, $a=b$ (where a, b, c are the three velocities represented in the order of magnitude). In this case then the ellipse has b and c for the ratios of its principal axes, the radius of the circle being represented by b; the wave-surface then becomes defined by a sphere, and a prolate spheroid touching the sphere internally, the common axis of the two figures being on the axis of least velocity. This, then, would be a uniaxal crystal, positive in optical character, the ordinary ray being the quicker, and represented by the (external) sphere. Where $c=b$ the crystal is negative, the common axis is that representing the greatest wave-velocity; the ellipse is external to the sphere and the ordinary becomes the slower wave. So, too, a biaxal crystal will be conventionally termed positive or negative according as its first mean line coincides with the axis of least or greatest elasticity. Returnnig to the subject of dispersion, it was shown that this character presented itself under two conditions: one, in which the directions of the axes of wave-velocity were the same for all colours; the other, in which the directions of those axes were not coincident. Without entering upon an explanation of the beautiful isochromatic curves, and the black cross or black hyperbolas intersecting the optic "eyes" of a crystal when examined in a polarising apparatus, it was shown that, whereas in the case of the plane containing the optic axes lying in or being perpendicular to the plane of polarisation, the figure for any one colour —say red—would be black at the point of emergence of an optic axis, but red around it, and then rings alternately *black and red* in the case; of the plane being at an angle of 45°, the axial point would be red surrounded by a black ring, and then rings alternately *red and black*. The result of this last case is, that if the blue "eyes" were external to the red, the "eye" which is black, as far as the red is concerned, would be illuminated by the first blue ray, &c. Whence the character of the dispersion may be predicated as being in the inverse order of the colours which fringe the hyperbolas on their inner and outer edges as they traverse the "eye" of the section.

As to the kind of symmetry which crystals may present it will be obvious that, in the ortho-rhombic system, dispersion of the optic axes is alone possible, the mean lines necessarily coinciding in direction with the crystallographic axes. Thus sections of crystals of cerussite, arragonite, and barytes were exhibited on the screen by means of the electric light and polarising apparatus, the first illustrating the case where the red rays are more dispersed than the blue, whilst in the second and third the blue rays are more dispersed than the red. Sections of Brookite and ammonic-magnesic-chromate were shown, to illustrate the case of crystals in which the first mean line for red coincided with one axis, that for bluen with a axis perpendicular to it. In the oblique system, with its single plane and single axis of symmetry, the conditions for dispersion are more widely varied: in this system, besides the dispersion of the optic axes, we have three kinds of dispersive distribution of one or other of the mean lines:—1. The first mean line may coincide with the axis of symmetry, the second mean line and normal line lying in the plane of symmetry in which they may be distributed. This is tne *crossed dispersion* of Des Cloizeaux: it was illustrated by a section of a crystal of borax; the isochromatic figures in this case are centro-symmetrical. This may be termed *centro-symmetrical dispersion*. 2. The second mean line coincides with the axis of sym-

metry, the first mean line being distributed in the plane of symmetry. In this case the figures presented are symmetrical to a line perpendicular to the line that would join the optic axes for any particular colour. It is the horizontal dispersion of Des Cloizeaux. It was illustrated by Adularia. It might perhaps be more correctly called *perpendicular dispersion.* 3. The first and second mean lines are distributed in the plane of symmetry; the figures are in this case symmetrical to the line passing through the centres of all the "eyes," which is the trace of the plane of symmetry. This is the *inclined dispersion* of Des Cloizeaux, and might be called *euthysymmetrical dispersion.* This variety was illustrated by a section of gypsum, and the effect of heat in changing the character of the dispersion into a dispersion of the horizontal kind was most beautifully shown, the optic axes closing in upon the centre of the figure, but unsymmetrically, by reason of the axial dispersion, and then opened out again along a line perpendicular to their former direction. In the anorthic system, where there is no coincidence of the mean lines with any crystallographic axis, either of the kinds of dispersion last described may concur together with axial dispersion.

The lecturer then proceeded to discuss the mode of determining the symmetry or system of a crystal by finding the directions in it, or in sections cut from it, in and perpendicular to which light vibrations will be performed,—*i.e.*, the determination of the directions of maximum darkness, when the crystal or the section is turned round between crossed Nicol's. The first thing to know is the plane of polarisation of the entering light, which we will suppose to be indicated by a vertical spider-line in the eye-piece of a microscope. A minute crystal or crystals may now be placed on the stage of the microscope, and the stage revolved until the light ceases to pass through one or other of the crystals. With the aid of a rotating spider-line and a graduated circle, the direction of any of the edges of the crystal may now be determined in respect to the vertical spider-line,—*i.e.*, in respect to the directions of the principal sections of the particular section of the crystal. By comparing the results obtained in this way from the various crystals with the kinds of symmetry which prevail in different systems, it is often possible to determine the system to which the crystals belong. When we are dealing with crystals in which the optical characters have been determined, it is generally possible to identify the substance, provided its crystallography and optical characters have been well studied. A beautiful application of this principle in the latter form is that by which Des Cloizeaux discriminated between the felspars, by determining the angle in which the trace of the plane of the optic axes intersects with the edge formed by the planes of clearage. Sections of the felspars were exhibited on the screen, including some of microline, the felspar in which Des Cloizeaux has recently recognised a potash isomorph of albite, so that the potassium felspar is now known to be dimorphous. The method of determining the exact position of maximum darkness in a section or a crystal has recently been greatly enhanced in delicacy, by M. Emile Bertrand, by means of a quadrant biquartz plate, with the aid of which the slightest deviation to right or left of the crystal from its true position imparts tint to the little plate which is placed in the focus of the eye-piece. This instrument was exhibited on the lecture-table.

Prof. Odling, in proposing a vote of thanks (which was carried by acclamation), said that the Fellows must feel greatly obliged to Prof. Maskelyne for his endeavours to re-associate chemistry and crystallography, and all must have appreciated the lucid and earnest lecture as well as the novel and beautiful illustrations.

In his reply to the unanimous vote of thanks, Professor Maskelyne mentioned that a Crystallological Society had been formed to carry out some of the objects which he had mentioned in his lecture. It consisted of chemists, to make suitable groups of crystals, and of crystallographers, to examine the crystals when made.

The Society then adjourned to Thursday, April 19th, when the following papers will be read:—"On the Estimation of Manganese in Spiegeleisen, and of Manganese and Iron in Manganiferous Iron Ores," by E. Riley. "On certain Bismuth Compounds," Part V., and "On a Method for Detecting Small Quantities of Bismuth," by M. M. Pattison Muir.

CORRESPONDENCE.

ELECTRO-DEPOSITION OF ALLOYS.

To the Editor of the Chemical News.

Sir,—By working an electro-brassing solution that contains cyanide of potassium and tartrate of ammonium at very little above the freezing-point, nearly pure zinc is obtained on the negative plate; as the heat increases the deposit changes in tint, and at one degree of heat it becomes of a perfectly silvery hue. On still raising the heat the deposit becomes yellow in colour.

The zinc-copper alloy of a silvery hue may or may not have some relation to Lavœsium.—I am, &c.,

W. H. Walenn.

74, Brecknock Road, N., April 7, 1877.

MOSS COPPER, &c.

To the Editor of the Chemical News.

Sir,—With reference to the the letters which have appeared in the Chemical News under this heading I can quite corroborate the remarks of Mr. T. A. Readwin. Early last year I had an opportunity of seeing Mr. Readwin's remarkable collection of British gold specimens at his house, when he was kind enough to show me a vast number of specimens, in which the gold was manifestly "growing" from the pyritous and siliceous matter with which it was associated.

Mr. Readwin then gave me a specimen of argentite from his cabinet, which was sending out wiry shoots of metallic silver. I placed this in a glass-topped box considerably larger than the specimen. I now find—April, 1877—that the silver has "grown" upwards to such an extent that it is flattened against the glass of the box, like the nose of a city arab against the window of a cookshop.

Many of my friends here have observed similar phenomena of mineral growth.

The whole subject of the relations of time to the formation of minerals is most interesting, and it would very much assist this important line of investigation if collectors would narrate their experience.—I am, &c.,

J. H. Collins.

Truro, April 7, 1877.

SUPPOSED DELETERIOUS INFLUENCE OF MOONLIGHT ON ANIMAL FOOD.

To the Editor of the Chemical News.

Sir,—While on a voyage up the Mediteranean I remarked the care the sailors took to remove out of the moonlight some pilot fish which had been caught and were being exposed in order to cure. On expressing astonishment, I was assured that the moonbeams had the property of rendering meat and fish poisonous. All the crew were unanimous in this opinion, and the captain (an old salt) went so far as to give instances from his experience—particularly one case, in which one of his crew became

seriously unwell that his life was despaired of, his illness being unhesitatingly ascribed to his having eaten fish that had been exposed to the moon's influence. The symptoms as detailed were undoubtedly those of poisoning, but it occurred to me that they might be due to salts of copper having found their way into the food or water, as occasionally happens on long voyages from the condenser becoming foul. This, however, was a sailing vessel, and as they did not distil their water supply, the chances of contamination in this manner were fewer. Can any of your readers say if there are any physiological grounds for this belief, or if not suggest an origin of this curious superstition?—I am, &c.,

SELENE.

March 30, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 13, March 26, 1877.

Presence of Benzol in Coal-gas.—M. Berthelot.—The author considers that the illuminating power of Paris coal-gas is mainly due to the vapour of benzol, the presence of which he shows at some length. Other liquefiable hydrocarbons are found in much smaller proportions.

Recent Communication by M. Weddell concerning the Advantage of Substituting Cinchonidin for Quinine.—M. Pasteur.—The author disclaims the discovery of cinchonidin, which had been attributed to him by M. Weddell.

Digestion of Albumen.—M. P. van Tieghem.—This is a botanical paper, relating to the germination of seeds.

Theory of Frigorific Machines.—M. A. Terquem.—A mathematical paper, not suited for abstraction.

Reflection of Polarised Light.—M. Crouillebois.—The same remark applies to this paper.

Transformation of Crystalline Sugar into Inactive Glucose in Crude Cane-sugars.—M. U. Gayon.—The reducing sugar present in crude cane-sugars is a glucose without action upon polarised light. The transformation in questiou is due, not to the acidity of the sugars, but to a real fermentation.

Composition of Gun-cotton.—MM. P. Champion and Pellet.—The authors seek to show that gun-cotton, as prepared by Prof. Abel's process, is a pentanitrated process, and not, as generally considered, trinitro-cellulose.

Series of Quinolines: Transformation of Leucoline into Aniline.—J. Dewar.—Not suitable for abstraction.

Nitro-toluquinon and Chloranilic Acid.—M. A. Etard.—Nitro-toluquinon is obtained by the action of chloro-chromic acid upon nitro-toluen. It is, in the opinion of the author, the first in the series of the cresylic quinons.

Sewage of Paris.—M. Ch. Lauth.—The author has analysed some sewage, determining the organic nitrogen in the soluble and insoluble portions by the soda-lime process. He states that if filtered the sewage may be preserved for two months without the production of any offensive odour. He has also experimented on the treatment of sewage by air and by the lime process.

Antiseptic Properties of Bichromate of Potassa.—M. Laujorrois.—The author finds that beer mixed with 1-100oth part of bichromate does not turn sour. Meat, gelatine, and vegetable matters can be preserved by its agency, even if freely exposed to the air. He found, however, that dogs—very judiciously in our opinion—declined to eat meat thus preserved.

Bulletin de la Societe Chimique de Paris, No. 3, February 5, 1877.

Researches on Melezitose.—M. A. Villiers.—Melezitose is a variety of sugar obtained from *Alhagi maurorum*, a leguminous shrub found in Persia and India, in the exudations of which this compound is found along with cane-sugar. It is dextro-rotatory, and in an anhydrous state requires the formula $C_{24}H_{22}O_{22}$.

Remarks on the Preceding Communication, and on the Constitution of Sugars Isomeric with Cane-Sugar.—M. Berthelot.—The author considers it useful to point out that theory pre-indicated the existence of several isomeric saccharoses derived from one and the same glucose, and capable of reproducing it.

Purification of Valeric Acid.—M. Lescœur.—The author forms an acid valerate by dissolving one of its neutral alkaline salts in rather more than two equivalents of the crude acid, crystallising, draining the crystals first on porous tiles, and then pressing between folds of blotting-paper. The crystals are then decomposed by treatment with luke-warm water, when valeric acid is liberated as an oily layer.

Precipitation of Phosphoric Acid by Ammonia in Presence of Lime, Baryta, Magnesia, Alumina, and Ferric Oxide.—M. H. Pellet.

Determination of Alumina and Ferric Oxide in Presence of Phosphoric Acid.—M. H. Pellet.—These two papers will be inserted in full.

Solubility of Certain Salts of Cadmium and others employed in Photography.—M. J. M. Eder.—This paper, abridged from *Dingler's Journal*, consists essentially of a table of solubilities.

Influence of Silica on the Determination of Phosphoric Acid by the Molybdate of Ammonia.—M. E. H. Jenkins.—In this paper, taken from the *Journal für Praktische Chemie*, the author maintains that the presence of silica does not interfere, as usually supposed.

Absorption of Ammoniacal Gas by Sulphate of Lime.—M. E. H. Jenkins.—The author finds that anhydrite does not absorb ammoniacal gas at ordinary temperatures, at 50° or at 100°. The same holds good with natural gypsum and with calcic sulphate, whether precipitated from a hot or a cold solution. If the same substances have lost a part of their crystalline water they absorb small quantities of ammonia, the proportion increasing with the temperature.

Pennsylvanian Gas-Springs.—J. Lawrence Smith.—The author, in a paper contributed to the *Annales de Chimie et de Physique* (viii., 566), describes certain wells, one of which discharges a million cubic feet of lighting-gas per hour. Its value is equal to seven standard candles, and it contains a little carbonic oxide and carbonic acid.

Remarks on the Effect of Acids upon Vegetable and Animal Fibre.—M. J. Weissner.—The author shows that vegetable fibre (mixed, *e.g.*, with wool) may be completely destroyed by steeping for an hour in water containing from 1 to 2 per cent of sulphuric acid, and subsequent exposure to a temperature of 50° to 60°. Animal fibre, on the contrary, is strengthened by a similar treatment with water containing from 3 to 4 or 5 per cent of acid, and subsequent exposure to a heat of 60° to 65°. If the acid liquid is stronger, containing 7 or 8 per cent, the fibre is weakened.

Preparation of Anthraquinon by the Action of Chloride of Lime and a Metallic Salt upon Anthracen.—M. A. Henniges.—On mixing anthracen with manganous chloride and chloride of lime there is precipitated manganic oxide, which oxidises the anthracen to anthraquinon. In three hours the reaction is complete; the

manganese is removed by means of an acid, and the anthraquinon is purified by sublimation. But it still contains 18 per cent of chlorine. If chloride of platinum is used instead of that of manganese, the product contains 12·25 per cent of chlorine, and if chloride of cobalt be employed we find merely 2 per cent. The chlorine thus present is not combined with the anthraquinon, but belongs to a secondary product. Certain metallic salts convert anthracen directly into anthraquinon. We obtain the latter compound by moistening with water a mixture of equal parts of anthracen and ferric chloride, heating to 100°, and adding from time to time a little water. After twenty-four hours the product is washed with acidulated water, which leaves crude anthraquinon. Thus 100 grms. of sublimed anthracen gave 116 grms. of crude anthraquinon, which latter yielded 9·6 grms. of sublimed anthraquinon. Nitrate of iron acts in an analogous manner, 10 grms. of anthracen producing 3 grms. of sublimed anthraquinon. Lastly, the author arrived at the same result by digesting the anthracen with peroxide of manganese and sulphuric acid, diluted with an equal volume of water. The reaction begins spontaneously, but it requires to be completed by keeping the mixture in the water-bath. The product thus obtained is purer and more abundant than that yielded by the methods previously mentioned.—*Dingler's Journal.*

Biedermann's Central-Blatt für Agricultur Chemie, Heft 1, 1877.

Concentrated Molasses Waste as a Dressing for Soils that are "Turnip-Sick."—F. E. Schoch, Prof. Märcker, and Dr. Heidepriem.—The treacle from beet-root sugar works is chiefly converted into alcohol, and the residue, containing the salts and nitrogenous matter, has been very successfully used on turnip-sick soils.

Action of Phosphates upon Calcareous Soils.—E. Damourette.—Contrary to the author's expectations phosphates gave upon these soils a better result than nitrogenous manures, the action of sulphate of ammonia alone being rather injurious. Superphosphate produced a gain, which may be represented by the figures +134, and sulphate of ammonia a loss corresponding to −31.

Substitute for Animal Charcoal.—Dr. Melsens.—The author steeps wood in the waste liquor of gelatine works (a solution of phosphate of lime in muriatic acid) or in solution of sulphate of magnesia, and then carbonises. The charcoal thus obtained has great decolourising power.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 37, January, 1877.

This issue contains no chemical matter.

Gazzetta Chimica Italiana. Anno vii., 1877, Fascicolo i.

Certain Paraffins and other Homologous Hydrocarbons found in a Specimen of Lava from Etna.—Prof. Orazio Silvestri.—In the lava of a certain district, about 22 kilometres in a direct line from the great central crater of Etna, the author finds a solid crystalline matter, easily fusible, a heavy reddish brown oil, solidifying below 0°, sulphur crystallising in monoclinar prisms, and a further quantity of sulphur forming trimetric octahedra.

Normal Propyl-benzol and Propyl-phenol.— E. Paterno and P. Spica.—Not adapted for abstraction.

Preliminary Note on the Derivatives of Naphthalin.—J. Guareschi.—The author treats of nitro-naphthalin, nitro-naphthalic acid, dinaphthyl, and bromo-binitro-naphthin.

Chemical Constitution of Benzol, Phenol, and some of their Derivatives.—H. Kolbe.—A paper translated from the *Journal für Praktische Chemie*, combatting the hypothesis of Kekulé on the constitution of these bodies.

Reimann's Färber Zeitung, No. 12, 1877.

The only important paper in this issue is a notice of chrysoidin, taken from the *Berichte der Deutschen Chem. Gesellschaft.*

Les Mondes, Revue Hebdomadaire des Sciences, No. 12, March 22, 1877.

This issue contains no chemical matter. The attack on the astronomer Flammarion is resumed, and the orthographical controversy, granite or granit, is still raging.

Royal Institution.—Mr. James Dewar, F.R.S.E., Jacksonian Professor of Natural Experimental Philosophy in the University of Cambridge, has been elected Fullerian Professor of Chemistry in the room of Dr. Gladstone, resigned.

MEETINGS FOR THE WEEK.

MONDAY, April 16th.—Medical, 8.
— Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.
TUESDAY, 17th.—Civil Engineers, 8.
— Zoological, 8.30.
— Royal Institution, 3. "Chemistry of the Heavenly Bodies," Prof. Gladstone.
WEDNESDAY, 18th.—Society of Arts, 8. "The Modification which Ships of War have undergone during the last Twenty Years," E. J. Reed, M.P., C.B., &c.
— Meteorological, 7.
THURSDAY, 19th.—Royal, 8.30.
— Society of Arts, 8. (Chemical Section). "Spontaneous Combustion in Factories and Ships." C. W. Vincent, F.C.S., F.R.S.E.
— Royal Institution, 3. "Heat," Prof. Tyndall.
— Chemical, 8. "Estimation of Manganese in Spiegeleisen, &c." E. Riley. "On Bismuth Compounds, Part V.," and "On a Method for Detecting Small Quantities of Bismuth," by M. M. Pattison Muir.
FRIDAY, 20th.—Royal Institution, 9. "Spinoza," Mr. F. Pollock.
— Society of Arts, 8. (Indian Section). "The Existing and Possible Commercial Communications between Persia and India," Major-General Sir Frederick John Goldsmid, C.B., K.C.S.I.
SATURDAY, 20th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.

THE
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THE CHEMICAL NEWS.

VOL. XXXV. No. 908.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

(Continued from p. 150.)

III. *Properties of Pure Gallium.*—Gallium is a greyish white metal having a fine lustre, but tarnishing slightly in moist air on account of superficial oxidation. The colour and brilliancy are notably diminished as soon as the metal begins to solidify. In a liquid state (in superfusion for example) it is of a beautiful silvery white, but if any part of its surface comes in contact with a trace of solid gallium a spot is seen to form which rapidly spreads; and on crystallising it assumes a very decided bluish tint, and its lustre diminishes. Gallium is liquefied by the heat of the hand.

On a first trial made in April, 1876, the point of fusion was found to be between 29° and 30°—say about 29·5°. I have just tested six samples of gallium deposited successively from one and the same solution. Under such conditions the presence of foreign metals would be shown by the difference in the fusibility of the various fractions collected. The following are the numbers I obtained:—

	Points of Fusion.
Gallium No. 1..	+30·14°
,, ,, 2..	+30·16°
,, ,, 3..	+30·14°
,, ,, 4..	+30·15°
,, ,, 5..	+30·16°
,, ,, 6..	+30·16°
	+30·15°†

This gallium appeared then to be very pure. In order to satisfactorily prove that traces of potassium did not contribute to the great fusibility of gallium I placed the sample No. 4 in boiling water for two hours. The metal was reduced to powder consisting of a multitude of very minute globules, which were united, not without some loss, by compression under warm water. The fusion-point of the small mass thus obtained had not varied in the slightest degree, consequently the gallium contained no potassium. The six samples of gallium having been mixed, a fragment weighing 2¼ centigrammes, was kept for half an hour in nitric acid diluted with its own volume of water. The temperature varied from 60° to 70°. The loss did not amount to 1 milligrm., including the small globules which had escaped when the metal was united into one mass. The fusion-point had not varied during this operation, for the metal melted *very slowly* at +30·16°, and solidified *very slowly* at +30·06°. When it has been completely melted gallium is very readily kept in superfusion. This explains how it is that a globule remained liquid for several weeks at temperatures falling occasionally almost to zero.

The superfusion of gallium ceases on coming into contact with the smallest particle of the same solid metal. It is interesting to notice that gallium preserves its liquidity, whether on plates of platinum or after contact and repeated rubbings with a steel rod.

When the solidification of a rather large mass of superfused gallium* is effected and placed in a room kept a few degrees below 30°, it is observed that the metal possesses a marked tendency to crystallise. If it is afterwards dissolved in dilute hydrochloric acid, not only does it assume a crystalline and shining texture, but broad and well-defined surfaces are developed, which makes the whole mass look at times like a single crystal. I have recently succeeded in preparing metallic gallium in the form of based octahedra, which I am occupied in measuring. Once solidified, gallium is hard and resistant, even at a few degrees below its fusion-point. It can, nevertheless, be cut, and is flexible and malleable. At about 30·15°, gallium adheres to glass, on which it forms a fine mirror, which appeared to me whiter than that produced by mercury. With warm water the gallium is easily detached from the glass.

The surface of the metal in fusion is soon covered with a pellicle of metallic appearance, but doubtless formed of oxide, under which a little wave, very mobile, is seen to pass when the vessel is leaning.

Heated to bright redness in presence of air gallium does not volatilise, and only oxidises very superficially. When cold the metal has only to be rubbed with a rod to restore its original brightness.

If a sheet of platinum covered with gallium is heated to redness, the latter becomes alloyed with it, and resists the action of hydrochloric acid; it is, however, dissolved with weak aqua regia together with traces of platinum. At the same time a slight whitish pellicle is detached, formed, probably, of oxide of gallium, which calcination renders difficultly soluble in acids. The solution in aqua regia gives the spectrum of gallium.

In May, 1876, I tried to determine approximatively the density of the new metal on a sample weighing 64 milligrms. I obtained 4·7 at 15° C. with reference to water at the same temperature. The mean specific gravity of aluminium and indium being about 4·8 at 0°, that found provisionally for gallium seemed to agree tolerably well with a theory which would place the new metal between indium and aluminium. However, the calculations established by M. Mendeleef for a hypothetical body which seems to correspond to gallium, at least in its general properties, point to the number 5·9°.

As soon as I had prepared a fresh supply of pure gallium I continued my researches as to its density, and I found that gallium crystallised under water, decrepitates sometimes when heated, which leads me to think that in my first experiment the metal perhaps contained interstices filled with air or water. I am ignorant whether this cause of error combined with others to falsify my first determination. However this may be, I avoided it afterwards by subjecting the metal to a strong heat, and solidifying it in a dry atmosphere. By these means I obtained higher densities, varying from 5·5 to 6·2, although the samples experimented with did not weigh more than a few centigrammes.

I then operated on a single ingot of pure gallium weighing about 58 centigrms., formed by the union of the six samples mentioned above. The density of this ingot I found to be at +23° (and referred to water at +23°)—

First experiment	5·900
Second experiment	5·970
Mean	5·935

M. Mendeleef's prevision is thus completely verified.

The same gallium was afterwards maintained for half-an-hour between 60° and 70° in nitric acid diluted with its own volume of water, then washed, very strongly heated, and finally solidified in dry air. The following are the results of this experiment:—

* Communicated by the Author.

† As it is rather difficult to fix upon the precise instant in which the minute masses of gallium show the first signs of fusion, I think that +30·15° is by a few centièmes rather over than under the true point of fusion.

* Some centigrammes at least.

Tare of the flask full of water ..	24·27905 grms.
Tare of the flask with gallium ..	23·80155 ,,
Increase of weight	0·47750 ,,
Weight of dry metal	0·57385 ,,
Water expelled	0·09635 ,,

$\frac{0·57385}{0·09635} = 5·956$ at the temperature of +24·45°.

The action of the nitric acid having altered neither the fusion-point nor the density, my present gallium may be considered very pure.

The flask which had just been used for the preceding determination was placed for a few minutes (with the gallium it contained) in a water-bath at 50° or 60°, and then cooled. The metal remained in superfusion, its density being taken as follows:—

Tare of the flask full of water ..	24·27920 grms.*
Tare of the flask with metal ..	23·79990 ,,
Increase of weight	0·47930 ,,
Weight of dry metal	0·57385 ,,
Water evaporated	0·09455† ,,

Thus liquid gallium appeared to be rather denser than solid gallium. Further experiments are, however, required to settle this question, for it is possible that the solid metal may still have contained some pores or cavities which disappear when it is melted. The difference observed is scarcely beyond the limits of error liable to be made with the imperfect apparatus at my disposal.

Gallium is dissolved in the cold, and more rapidly by the application of heat in hydrochloric acid, hydrogen being rapidly evolved. It is not sensibly attacked in the cold by nitric acid, but with the aid of heat it dissolves, with the evolution of rutilant fumes. A solution of caustic potassa dissolves gallium with the evolution of hydrogen. This observation was made by M. Fremy.

The gallium electrolysed by an ammoniacal solution is identical with that obtained by means of a potassic solution. The differences I at first noticed were owing—(1) to the presence of traces of foreign metals; (2) to the effects of superfusion presented by the gallium. It is impossible to determine at present the uses to which the new metal will be put in science and commerce, but it is easy to foresee that its very exceptional properties will be utilised for purposes for which the other metals are unsuitable.

IV. Spectrum of Gallium.

The most remarkable reaction of gallium is the formation of two beautiful violet rays when the surface of a saline solution of that metal is submitted to the action of the induction spark. These two rays have all the characteristics of rays produced by the metal itself, and not by one of its compounds. To obtain a fine electric spectrum of gallium, the exterior positive conductor must not be brought too near the negative solution: a very short spark should not be used, but one of medium length, *i.e.*, about 1½ to 2 millimetres.

On introducing the chloride of gallium into a gas-flame only a feeble and fugitive trace of the least refrangible violet ray is observed. This method, though an excellent one for alkalies, indium, thallium, &c., cannot be employed in researches connected with gallium.

*Electric Spectrum of the Chloride of Gallium.**

Position on my Micrometer.	λ.	Observations.
α 193·72	417·0	Narrow; *strong*; decidedly more brilliant in a spark of mean length than in a very short one.
β 208·90†	403·1	Narrow; well marked; but much weaker than *α* 193·72. Much brighter with a medium than with a very short spark.

The ray Ga*α* 417·0 is characteristic of gallium, and is a very sensible reaction. The gallium spectrum is, however, less brilliant than that of indium. I have not observed any other rays that I can *with certainty* attribute to gallium; those I have perceived are weak under the conditions in which I work, even with concentrated chloride of gallium. I am still pursuing the subject.

V. Action of Some Reagents on the Compounds of Gallium.

1. *Metallic Zinc.*—So long as the liquids are sensibly acid, and the evolution of hydrogen goes on actively, zinc does not precipitate either the chloride or sulphate of gallium, but when the liquids become basic, and hydrogen is evolved very slowly, the oxide of gallium (or more probably a sub-salt) is separated in white flakes mixed with sub-salts of zinc.‡ If there be any alumina it is found in the same deposit as the gallium. It is, then, in reality a sub-salt of zinc previously formed which precipitates the gallium: so, to render the latter insoluble, the gallium solution of chloride of zinc must be heated up to the point when, hydrochloric acid being expelled, it has become basic. The concentrated liquid may still be limpid, but if it is diluted with a great deal of water it yields oxychloride of zinc, and with it oxide of gallium. The precipitation of oxide of gallium by zinc is rather slow in the cold. In small volumes it takes a few days, but in a large volume it is scarcely completed in less than three weeks or a month, according to the season. At a temperature equal to boiling-point only a few hours are required.

2. *Cadmium.*—A sheet of cadmium precipitated nothing from a solution of chloride of zinc rich in gallium, even after boiling for a long time.

3. *Ammonia.*—An excess of this reagent precipitates gallium salts, of which a notable proportion remains in the liquid, notwithstanding the presence of ammoniacal compounds. By dissolving with hydrochloric acid the part not dissolved by an excess of ammonia, and re-commencing the operation, all the gallium in ammoniacal solution is promptly obtained. The solubility of the oxide of gallium in ammonia exceeds that of alumina under the same circumstances,§ for when a mixture of chlorides of aluminium and gallium is treated several times with an excess of ammonia, the first of the ammoniacal solutions becomes very rich in gallium, and the last of the precipitates consists exclusively of alumina. A single precipitation by means of a large excess of ammonia is sufficient to yield, on the one hand, a gallium salt poor in aluminium, and, on the other, alumina containing little gallium. When ammonia is added drop by drop to some chloride of zinc

* Taken immediately after the gallium had been taken away.

† The weights relating to the density of liquid gallium were taken only once, while for solid gallium they were each taken twice, and the mean of the two numbers obtained was employed. Upon the whole, the experiment with solid gallium was performed under rather better conditions.

* The relative intensities indicated in this description relate to the mean concentration of the solution employed for the execution of the present drawing.

† The ray Ga*β* is more difficult to measure than Ga*α*; I do not, however, think that the error in λ much exceeds 0·1. The wave-lengths found by MM. Delachanal and Mermet are Ga*α*=417·1 and Ga*β*=403·3. (*Bulletin de la Société Chimique de Paris*, March 5, 1877.)

‡ The metals precipitated by the zinc of a solution rich in gallium contain very sensible traces of that body. Does it exist in the state of oxide confined in the metallic sponge, or is it reduced in small quantity by being *drawn down?* In any case it suffices to re-dissolve the metals, and to repeat the reduction by zinc in order to eliminate the little gallium contained in the first deposit.

§ It is known that to make a good precipitation of alumina by ammonia the liquor must contain ammoniacal compounds. All chemists do not, perhaps, take into consideration the relatively large quantity of alumina which is dissolved in very pure ammonia. Such a solution precipitates *abundantly* when a few drops of solution saturated with an ammoniacal salt are poured into it.

containing a little gallium, the latter is precipitated before the zinc, and is rapidly concentrated in the first deposits. The liquid seems not to contain any appreciable quantity of gallium.

4. *Carbonate of Ammonia.*—This salt behaves in many respects like free ammonia. It dissolves oxide of gallium. At present I have not well studied its action.

5. *Fixed Caustic Alkalies.*—A small quantity of potash precipitates the oxide of gallium, and acts then like ammonia, but the precipitate is extremely soluble in an excess of the reagent.

6. *Alkaline Carbonates.*—If carbonic acid gas is made to pass into the potassic solution of oxide of gallium, the latter is separated again; it is then easily soluble in dilute sulphuric and dilute hydrochloric acids, as well as in dilute potassa. Carbonate of soda precipitates gallium salts in the cold and by the aid of heat. When a gallium chloride of zinc is treated fractionally with carbonate of soda, the gallium is concentrated in the first deposits. The separation is so complete that one of the precipitates may give the gallium rays much more brilliant than those of zinc, whilst the next shows a feeble image of the ray Gaα 417·0 and a bright spectrum of zinc. At a temperature equal to the boiling-point a very small quantity of carbonate of soda forms a thick precipitate in the gallium salts, which is re-dissolved as the liquor cools. This effect is due to the decomposition by hot water of some neutral salts of gallium, and to the combination of their elements on cooling. Alumino-ammoniacal alum, with or without the addition of acid acetate of ammonia, does not become turbid when boiled, whilst ammonio-gallic alum is strongly so, as will be seen further on. In a fractional precipitation oxide of gallium (or a sub-salt of that metal) ought to be deposited before the alumina. This conclusion seems to be justified by experiment. If a mixture of salts of aluminium and gallium, in very small proportions, is precipitated by carbonate of soda, the rays Gaα 417·0 and Gaβ 403·1 are most intense in the first product, and afterwards go on diminishing; still we cannot in this manner arrive at a satisfactory separation of gallium and aluminium. Carbonate of soda only precipitates indium after gallium.

7. *Acetic Acid.*—The chloride and sulphate of gallium, slightly acid, are not precipitated by acid acetate of ammonia in the cold, but by the aid of heat the reaction takes place. The precipitate is in white gelatinous flakes, and is not dissolved in the presence of a moderate excess of acetic acid, even on boiling. However, if a large quantity of acid acetate of ammonia or acetic acid is added, the liquor remains limpid when heated. The neutral sulphate of gallium becomes turbid in the cold, when a little acid acetate of ammonia is poured into it; but a large quantity of the same reagent renders the liquid clear in the cold, and in that case it no longer grows turbid on heating unless water is added. An ammoniacal solution of sulphate (or chloride) of gallium is precipitated, both in the cold and in the heat, by an excess of acetic acid. This effect, however, ceases if the liquid be very dilute, or if the excess of acetic acid be very large.

8. *Sulphuretted Hydrogen.*—Slightly acid solutions of chloride and sulphate of pure gallium are not rendered turbid by sulphuretted hydrogen. Even in the presence of acid acetate of ammonia no precipitate is formed. The reaction of hydrosulphuric acid is quite different when the solution of gallium contains zinc. It is well known that the salts of zinc (chloride, sulphate, &c.), very slightly acid, are precipitated by sulphuretted hydrogen: the action is limited by the quantity of strong acid set at liberty. If the experiment is made with a chloride of zinc containing gallium, a notable quantity of this metal falls along with the sulphide of zinc. The precipitation of gallium is easier, without, however, being quite complete when the liquid rich in zinc is supersaturated with acid acetate of ammonia. If the salts of zinc are not sufficiently abundant to draw down at once the whole of the gallium precipitable by sulphuretted hydrogen, it must be added in small portions until these products no longer give the ray Gaα 417·0 in the spectroscope. Only very faint traces of gallium then remain in the liquid. In a mixture containing much chloride of zinc, notably of chloride of indium and chloride of gallium, the fractional precipitation, by means of sulphuretted hydrogen in the presence of acid acetate of ammonia, gives successively—

1. Much indium, a moderate quantity of zinc, traces of gallium.
2. A moderate quantity of indium, much zinc, considerable quantity of gallium.
3. Traces of indium, much zinc, considerable quantity of gallium.

The precipitation of sulphide of gallium* effected in the presence of salts of zinc offers a rather curious instance the effects which are produced in a very large number of chemical reactions, and which cannot be neglected in such researches as the present. If the precipitates of sulphides, obtained by successive addition of chloride of zinc to a solution rich in gallium, are examined by the spectroscope, it will be seen that they appear to remain at first almost constant, or at least to decrease slowly, then more and more rapidly until the ray Gaα 417·1 is no longer visible. Thus the quantity of gallium precipitated by sulphide of zinc does not seem to be a function of the richness of the liquid. Within certain limits it seems to be almost in proportion to the amount of sulphide of zinc formed. Is there not here an indication of a combination between the two substances, or perhaps more probably a surface-attraction analogous to the fixation of a colouring matter upon a mordant?

9. *Hydrosulphate of Ammonia.*—In the presence of salts of zinc, gallium is precipitated as much in neutral or acid solutions as in ammoniacal liquids. An excess of hydrosulphate of ammonia does not re-dissolve the gallium, unless, indeed, the sulphide of zinc be in such small quantity as to dissolve also.† If a neutral or slightly acid solution of zinc and gallium is treated with hydrosulphate of ammonia containing free ammonia, the gallium is concentrated on the first sulphides of zinc. If, instead of being neutral or acid, the solution of zinc and gallium is ammoniacal, the gallium is concentrated in the last sulphides. Hydrosulphate of ammonia does not precipitate an ammoniacal solution of chloride or sulphate of *pure* gallium.

10. *Carbonate of Barium.*—This reagent precipitates the oxide of gallium in the cold. I employed this method in my first researches to eliminate the greater part of the zinc with which any chloride of gallium was alloyed, but the separation is less complete than when submitted to fractional precipitation with carbonate of soda, for the carbonate of barium retains a considerable quantity of zinc with the gallium.

11. *Aqua Regia.*—Repeated evaporations with large excesses of aqua regia appear to occasion no loss of gallium by volatilisation of chloride.

12. *Ferrocyanide of Potassium.*—Very acid chloride of gallium is precipitated by yellow prussiate. I made the following experiment on a dilute solution of chlorides of zinc and gallium. To this solution I added 4-10ths of its volume of concentrated hydrochloric acid, then a slight excess of prussiate, and, lastly, four times its volume of water (under these conditions cadmium is not precipitated); all the gallium and all the zinc were contained in the deposit, which fact I ascertained by the spectral examination of the filtered liquid. The ferrid-cyanids of zinc and gallium were washed with rather strong hydrochloric acid,

* I suppose, but without having submitted it to experimental verification, that the white precipitate formed by sulphuretted hydrogen in acetate of gallium containing a little zinc is a sulphide and not an oxide.

† Sulphide of zinc is sensibly soluble in hydrosulphate of ammonia. Once having treated chloride of zinc with a large excess of hydrosulphate (yellow), I treated 0·754 grm. of sulphide of zinc with a litre of clear filtered solution; yet this does not define the limits of the solubility of sulphide of zinc.

then decomposed with hydrosulphate of ammonia. The hydrochloric solution of the sulphides gave brilliantly the zinc and gallium spectrum.

(To be continued.)

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.*

Third Paper.—Correction of the Errors Due to Variations of Temperature.

By P. CASAMAJOR.

(Continued from p. 132.)

In a paper "On a New Portable Burette," which I had the honour of reading before this Society at our November meeting, I called your attention to the fact that many chemists were unwilling to trust the processes of volumetric analysis, on account of the errors which resulted from the effect of variations of temperature on the strength of the test solutions. These chemists, however, very willingly avail themselves of the reactions of this branch of analysis, and they have adopted the plan of weighing their solutions instead of measuring them. For their use I gave a modification of the portable burette, adapted to being placed on the pan of a balance.

Although it is more accurate to weigh a solution than to measure it, it is difficult to give up the convenience and rapidity which belong to volumetric analysis, and I believe that most chemists prefer to measure their solutions, and many even have adopted the opinion that the errors resulting from variations of temperature are so slight as to be scarcely appreciable.

If we compare this opinion with that of the other chemists before mentioned, that these errors are so important that they are unwilling to trust volumetric analysis, it must strike us that in such an important matter we should have something better than opinions, and that it is desirable to know, with some precision, what degree of change may result from known variations of temperature.

I propose, now, to examine the effect of changes of temperature on the volumes of test solutions, and to give an easy method of correcting the errors resulting from these changes.

At the start I must call your attention to one point, that the reagents used in volumetric analysis are, with few exceptions, in a highly diluted condition, their principal constituent being water, which holds in solution small percentages of acids, alkalies, or salts. A liquid so constituted must expand and contract so nearly like pure water, that any errors which may result from taking for their changes of volume those of pure water must be so small as to be inappreciable.

To determine the changes of volume of water, which correspond to changes of temperature, I propose to make use of the data given by Dr. Matthiessen in his remarkable researches on the expansion of water, glass, and mercury, published in the *Philosophical Transactions* for 1866.† Dr. Matthiessen found that the expansion of water for a rise of 1° C. was different at different temperatures; that it increases as the temperature increases, although the rate of increase diminished. In Table No. I., given below, are to be found, at every five degrees, the fractions of 1 c.c., which represent the expansion of 1 c.c. for a rise of temperature equal to 1° C. The numbers given by Dr. Matthiessen range from 5° to 100° C., but I have not made calculations beyond 45°, which is a higher temperature than is ever attained in our laboratories.

For the researches that we have in view, we need the expansions for a rise of 1°, at every degree centigrade, so as to be able to calculate the total expansion from any degree taken as a normal. The numbers representing these expansions may be obtained by taking a series of

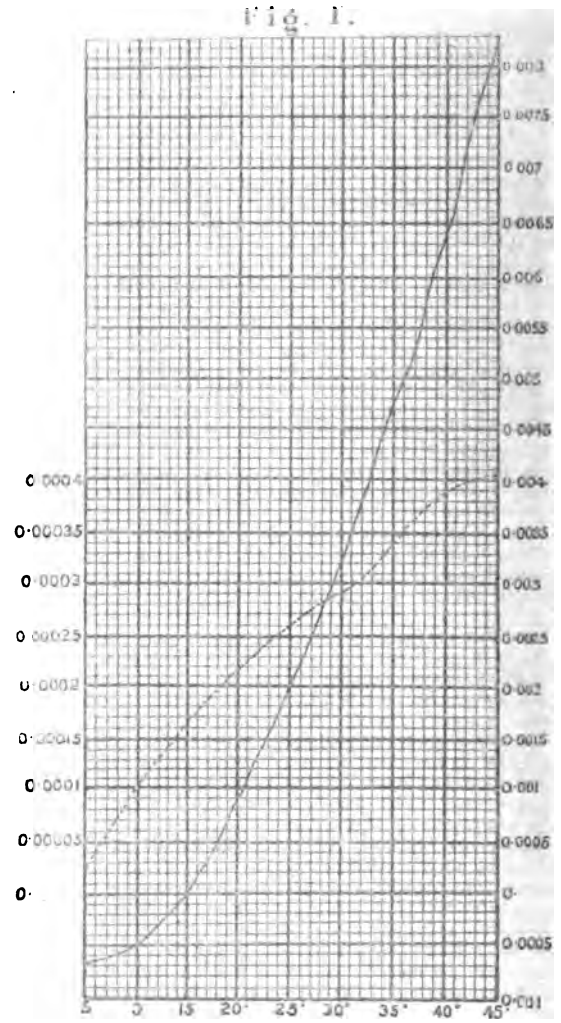
Table No. I.

Expansion of 1 c.c. of Water for a Rise of Temperature of 1° C.

At	5°	C. the expansion is	0·000022
,,	10°	,, ,,	0·000098
,,	15°	,, ,,	0·000162
,,	20°	,, ,,	0·000215
,,	25°	,, ,,	0·000259
,,	30°	,, ,,	0·000290
,,	35°	,, ,,	0·000345
,,	40°	,, ,,	0·000388
,,	45°	,, ,,	0·000428

perpendicular equidistant lines (see Fig. 1), and adopting, as the abscissæ, the degrees of the centigrade thermometer from 5° to 45°, and, as the ordinates, unities representing 0·00001 of a c.c. The latter numbers are marked on the left in the accompanying figure.

Fig. 1.



By marking on the vertical lines, corresponding to 5°, 10°, 15°, &c., distances from the o line representing the expansions for o° C. at these temperatures, and by connecting these points by a curved line, we are able to find the expansions for every intermediate degree of temperature. This is done by counting on every vertical line the number of divisions from the o line to the curve. This

* Read before the American Chemical Society, December 7, 1876.
† See Brooke's "Natural Philosophy," p. 761. London, 1867.

curve is the one drawn with a dotted line in Fig. 1. By drawing this curve with great care on a large scale, the following numbers were obtained for the expansion of 1 c.c. of water for an increase of 1° C. for every degree from 5° to 45°.

TABLE No. II.

Expansion of 1 c.c. of Water at every Degree Centigrade from 5° to 45° for a Rise of 1° C.

Degs. C.	Expansion.	Degs. C.	Expansion.	Degs. C.	Expansion.
5	0·000022	19	0·000205	33	0·000322
6	0·000036	20	0·000215	34	0·000333
7	0·000052	21	0·000224	35	0·000344
8	0·000068	22	0·000233	36	0·000353
9	0·000084	23	0·000242	37	0·000362
10	0·000098	24	0·000250	38	0·000370
11	0·000112	25	0·000259	39	0·000379
12	0·000124	26	0·000266	40	0·000388
13	0·000138	27	0·000272	41	0·000396
14	0·000150	28	0·000278	42	0·000404
15	0·000162	29	0·000284	43	0·000412
16	0·000173	30	0·000290	44	0·000420
17	0·000184	31	0·000300	45	0·000428
18	0·000194	32	0·000312		

The curve which affords the numbers in the preceding table is drawn in Fig. 1 with a dotted line. In the same figure there is another curve drawn with a full black line, which will be noticed hereafter. The dotted curve, which turns its concavity downwards and has quite a regular shape from 5° to 32°, afterwards becomes quite irregular, and, after turning its convexity towards the abscisses from 32° to 40°, becomes concave again with a lesser curvature, which continues pretty regular if the curve is prolonged to 100°. Dr. Matthiessen gave a complicated formula for the volumes from 4° to 32°, and another for those between 32° and 100°.

The figures of the preceding table, which give the expansion of 1 c.c. of water at every degree for a rise of 1° C., will enable us to calculate the total expansion of a volume of water at any temperature starting from any degree as a normal. Although 25° would be a very convenient temperature to take as a normal, as it represents very approximately the average temperature of our laboratories, I propose, in common with the generality of chemists and physicists, to adopt 15° as the temperature from which to calculate the expansions and contractions of our test solutions.

If we take 15° as a normal, we may enquire, What will be the expansion of 1 c.c. of water when the temperature increases to 16°?

In the table given above we find, opposite to 16°, the number 0·000173, which may be taken as the expansion at that temperature. If we wish to know the total expansion from 15° to 17°, we must take the number 0·000184, placed opposite 17° in Table No. II., and add it to 0·000173, which will give 0·000357. In the same manner to find the total expansion from 15° to 18°, we must add to the above number, 0·000357, the number 0·000194, and the sum will be 0·000551. We may proceed in the same manner, from degree to degree, up to 45°, by adding the expansion corresponding to each degree in Table No. II. to the sum of expansions of all the preceding degrees from 16°.

Below 15° we will take for 14° the number 0·000150, placed opposite 14° in the preceding table; for 13°, we will add to 0·000150 the number 0·000138, which will give the total 0·000288; and we may proceed in the same manner, adding the number opposite to each degree to the sum of the numbers corresponding to all the preceding degrees from 14° until we reach 5°. We must bear in mind, however, that for temperatures below 15° C. the numbers represent contractions, and are to be subtracted. The numbers thus obtained will give the second column of Table No. III.

TABLE No. III.

Total Expansions from 15° C.

Degs. C.	Absolute Expansion.	Relative Expansion.
5	0·000878	0·000612
6	0·000856	0·000622
7	0·000820	0·000612
8	0·000772	0·000590
9	0·000706	0·000550
10	0·000622	0·000492
11	0·000524	0·000420
12	0·000412	0·000334
13	0·000288	0·000236
14	0·000150	0·000124
15	Normal	Normal
16	0·000173	0·000147
17	0·000357	0·000305
18	0·000551	0·000473
19	0·000756	0·000652
20	0·000971	0·000841
21	0·001119	0·001039
22	0·001428	0·001246
23	0·001670	0·001462
24	0·001920	0·001686
25	0·002179	0·001919
26	0·002445	0·002159
27	0·002717	0·002405
28	0·002995	0·002657
29	0·003279	0·002913
30	0·003569	0·003179
31	0·003869	0·003453
32	0·004181	0·003739
33	0·004503	0·004035
34	0·004836	0·004342
35	0·005180	0·004660
36	0·005533	0·004987
37	0·005895	0·005323
38	0·006265	0·005667
39	0·006644	0·006040
40	0·007032	0·006382
41	0·007428	0·006752
42	0·007832	0·007130
43	0·008244	0·007516
44	0·008664	0·007910
45	0·009092	0·008312

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 14th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE SECRETARY described a new form of colorimeter, devised by Dr. Mills. It consists of two vertical glass tubes, about 10 c.m. in length and 2 c.m. in diameter, and contracted at their lower ends, which are graduated in millimetres and fixed in a frame. In each tube a loosely fitting disk of white or black glass (as occasion may require) can be raised or lowered from below by means of a glass rod fitting water-tight, and the meniscus at the surface of the liquid is concealed from view by a hinged screen, so that no confusion arises from a dark meniscus. The two liquids under examination are introduced into the tubes to the same level, and the disks adjusted until rendered invisible when the lengths of the columns are observed. Two solutions, containing respectively 1 part of magenta in 100 and 120 parts of water, were found to be in the ratio of 100 to 119·9.

Mr. CHRISTIE gave an account of a new form of spectroscope, in which "half-prisms" are used to magnify

he dispersion. He pointed out that the angle between two pencils is magnified by the action of a half-prism, which, from this point of view, is equivalent to a telescope with cylindrical lenses, the magnifying power being the ratio of the breadth of the incident pencil to that of the emergent. In consequence of this a half-prism will give great dispersion or great purity, according as the rays from the slit fall first on the perpendicular or oblique face, and it may be advantageously used in preference to the ordinary isosceles prism, and adapted to the special circumstances of an experiment. These two positions of the half-prism were distinguished as magnifying and diminishing. Incidentally Mr. Christie explained that the condition of minimum deviation, though essential in Newton's form of spectroscope, was rendered unnecessary by the introduction of the collimator, which makes the rays parallel before falling on the prisms, whilst with a half-prism—which is, of course, not at minimum deviation—there is the great advantage that different parts of the spectrum can be brought into the field by simply turning the prism about its centre, an arrangement which, besides its greater convenience, allows of the use of very large angles, since there is no excessive spreading out of the violet end of the spectrum. The case of a compound prism was then considered, and Mr. Christie mentioned that with a direct-vision half-prism a dispersion equivalent to that of ten ordinary prisms had been obtained without any loss of definition. Such prisms can be combined in trains, magnifying or diminishing according as great dispersion or purity is required; and from a comparison with the ordinary long train of prisms there appeared to be a balance of advantages in favour of the half-prisms. From the nature of the case great dispersion must always be accompanied by loss of light, whether by making it necessary to use a narrower slit to get sufficient purity, or by a decrease in the breadth of the pencil utilised, or by absorption in a great thickness of glass, and this increases very rapidly when the thickness of glass is increased; thus 50 per cent of the light is absorbed in passing through 3 or 4 inches of glass, and in a train of ten compound prisms, in which the rays traverse some 28 inches, the absorption was found to be more than 99 per cent. Most spectroscopes would give a much brighter spectrum if they had smaller prisms, but a high magnifying power could not then be applied. In the half-prism spectroscope, though the thickness of glass is far less, yet, as it should not exceed a total of 5 or 6 inches, there would be advantage in using composite prisms exactly similar and cemented side by side. Mr. Hilger has actually made a double prism on this plan which seems to answer perfectly. In illustration of these principles Mr. Christie exhibited three spectroscopes, recently made by Mr. Hilger, in which a wide separation of the sodium lines was obtained by means of two half-prisms (direct-vision), and explained the mechanical arrangement adopted to produce the rotation of the prisms, as well as the way in which an image of the slit is used to form a fiducial line in the field of view. He also showed that by reversing such a train of half-prisms very great purity is obtained, so that the sodium lines are seen in the light of an ordinary unsalted candle without the use of collimating lenses; and he mentioned that he had, in the same way, seen the Fraünhofer lines in the sun and moon.

Dr. HUGGINS called special attention to the convenience and portability of this form of spectroscope, as well as the great advantage of only employing 2 or 3 inches of glass, and he expressed himself as very favourably impressed with the few small instruments he had had an opportunity of examining.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

January, 1877.

L. BOLTZMANN, "*Notes on some Problems of the Mechanical Theory of Heat.*" The author shows from mathematical considerations that the specific heat of liquids, brought into consideration in the theories with regard to the properties of their saturated vapours, is neither that by constant pressure nor that by constant volume, being slightly greater than these both. The remainder of the communication is devoted to proofs of the mechanical theory of heat based on the principles of analytical mechanics.

C. O. CECH and P. SCHWEBEL, "*On a Peculiar Formation of Iso-cyanphenyl.*" (CHEM. NEWS, vol. xxxv., p. 63.)

February, 1877.

F. LIPPICH, "*On the Theory of Electro-dynamics.*" Taking Neumann's proposed potential expression for the pondero-motory action of two closed, similar, lineal currents on each other as the foundation of electro-dynamics, the author seeks to establish its correctness more directly than has hitherto been done, and bases the theory on the following four grounds:—(1) The principle of the conservation of energy is applicable for the pondero-motory action of any two similar closed currents, fixed or movable; (2) this action is dependent only on the form, intensity, and relative position of the currents: (3) the influence upon each of the two currents is composed of the influences on the individual components; (4) the force exerted by one of the currents on the other is entirely uninfluenced by the presence of other currents.

J. LASCHMIDT, "*On the Thermal Equilibrium of a System of Bodies with reference to Gravitation.*" The author proves that in a vertical column of gas the temperature of the upper strata is less than that of the lower, and then considers the probable effect of gravitation on the thermal equilibrium of the universe. The conclusions arrived at are that the history of the various solar systems consists of a succession of epochs marked in turn by the concentration of matter, evolution of heat, radiation of heat, cooling, renewed increase in the stock of heat, dispersion of the heated masses, and condensation.

F. EXNER, "*Diffusion of Vapours through the Films of Liquids.*" The results of experiments with the vapours of benzine, chloroform, alcohol, carbon bisulphide, and ethyl sulphide show that vapours obey the same law as permanent gases with regard to the diffusion through absorptive films, viz., the velocity of diffusion of different vapours is inversely proportional to the square roots of their densities, and directly proportional to the coefficients of absorption for the respective liquids forming the films.

March, 1877.

A. LIEBEN and G. JANSCEK, "*On Normal Hexyl-alcohol and Normal Œnanthylic Acid.*" Fermentation caproic acid was changed successively into caproic aldehyd, hexyl-alcohol, hexyl-iodide, and œnanthylic acid. The results of the investigation show that normal hexyl-alcohol is identical with the hexyl-alcohol obtained from the essential oil of *Heracleum giganteum*, and that normal œnanthylic acid is identical with the acids obtained from the oxidation of œnanthol, and from the oil of *Heracleum*.

L. LIEBERMANN, "*On Metanitro- and Metamido-benzacetylic Acid.*" The author describes the preparation of these two acids, and shows their structure to be as follows:—

$C_6H_4(NO_2)(CO.CH_2.COOH)$ and

$C_6H_4(NH_2)(CO.CH_2.COOH)$,

the latter being isomeric with hippuric acid, but distinguished from it by the double substitution in the benzene skeleton, and by the fact that the substitution does not take place in the amido group.

"*Action of Animal Charcoal on Salts.*" The author finds that the attraction of the charcoal for bases is much stronger than for acids, and that a large variety of salts are decomposed through its action, the acid being released in amounts which could be determined quantitatively. Nearly all chemical compounds are kept back in part by the filtration of their solutions through animal charcoal.

"*Solubility of Sulphur in Acetic Acid.*" All varieties of sulphur are found to be moderately soluble in warm concentrated acetic acid, although almost insoluble in ordinary dilute acids. By cooling or evaporation the sulphur is deposited in the form of long beautiful prisms.

"*Detection of Fuchsin in Wine.*" The strongly marked characteristic absorption-band between yellow and green, yielded by fuchsin solutions, permits of its detection, even in a dilution of 1 : 500,000.

J. v. JONSTORFF, "*Changes in Molecular Form.*" Crystals of iodine, preserved in a glass flask, and exposed for eight years to variations of temperature amounting to 0—24°, increased in diameter from 2·3 m.m. to 4·5 m.m. The change was probably due to volatilisation and subsequent condensation on the larger specimens. Amorphous phosphorus preserved under water and exposed to the same conditions as the iodine, was examined after a lapse of nine years, and found to contain a number of perfectly formed crystals of the ordinary form of phosphorus.

E. v. FLEISCHL, "*Estimation of the Internal Resistance of Galvanic Batteries.*" This is accomplished by joining together the two similar poles of two elements of the battery to be measured, and then comparing the resistance in this combination with a known resistance by means of Wheatstone's bridge.

F. HOFMEISTER, "*On Some Reactions of Amido-Acids.*" The author has examined the conduct of glycin, leucin, sarcosin, asparagin, aspartic acid, glutamic acid, and taurin, with a variety of reagents, and found that with the exception of taurin they yield a number of similar reactions, which can be used as group reactions for their detection.

"*Copper Salts of Tyrosin, Aspartic Acid, and Glutamic Acid.*" The composition and solubilities of these salts are described very fully.

"*Solubility of Copper Oxide in Alkaline Solutions of the Amido Acids.*" Quantitative experiments show that two molecules of glutamic acid, tyrosin. leucin, sarcosin, and glycin, and one molecule of asparagin and aspartic acid, are each able to hold one atom of copper in a state of solution in an alkaline liquid. The solubility is probably dependent on a chemical process and the formation of a double salt.

G. GOLDSCHMIEDT and G. CIAMICIAN, "*A Modification in the Determination of Specific Densities of Vapours.*" The authors determine the volume assumed by the vapours of a weighed substance after passing into the gaseous state by the weight of the displaced mercury. Satisfactory results were obtained with ether, phenol, naphthalin, and resorcin.

F. EXNER, "*Galvanic Expansion.*" The author's experiments show that the elongation experienced by a wire during the passage of a galvanic current is due simply to the heat developed by the current.

J. PULUJ, "*Diffusion of Vapours through Earthenware Plates.*" Experiments with alcohol, ether, and water show that their vapours diffuse through plates of porous earthenware, inversely as the square roots of the densities, with very slight variations of Graham's law. The velocity of diffusion increases with the temperature. The author shows, also, the incorrectness of Dufour's assumption, that dry air diffuses more rapidly than moist air by actual experiment.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

April 9th, 1877.

Prof. C. LIEBERMANN, Vice-President, in the Chair.

PROF. VOGEL stated, in connection with a recent communication of E. Schunck and H. Roemer, on "*Purpurin*," that his experiments convinced him that light played an important part in the decolouration of an alkaline solution of purpurin when exposed to the oxidising action of the air. Two test-tubes were filled with the solution and placed in the open air by daylight, one being protected, however, by a shield of black paper. In a short time the solution in the unprotected tube was completely decolourised, while the other was entirely unaffected.

A. MICHAEL gives a "*New Method of Preparing Paramido-Benzoic Acid*," preferable to that of oxidation and reduction of para-nitro-toluen, hitherto used on account of the saving in time and substance. Para-tolyl-succinimid, obtained by melting together equal weights of toluidin and succinic acid, is oxidised by a dilute solution of 4 molecules potassium permanganate, and yields oxy-succinyl-paramido-benzoic acid,—

$$C_2H_4(COOH)(CO.NH.C_6H_4.COOH).$$

This acid crystallises in yellow needles, melts at 225°, and gives a series of crystalline salts. By treatment with fuming HCl the insoluble hydrochlorate of paramido-benzoic acid is obtained, and this, upon further treatment with Na_2CO_3 and acidifying with acetic acid, yields paramido-benzoic acid, $C_6H_4(NH_2)(COOH)$. 100 grms. of tolyl-succinimid yield 35 to 40 grms. of the pure acid by this method. An analogous compound, oxyphthalyl-paramido-benzoic acid,—

$$C_6H_4(COOH)(CO.NH.C_6H_4.COOH,$$

insoluble, melting at 275°, was obtained in a similar manner from para-tolyl-phthalimid, and is likewise changed easily into paramido-benzoic acid.

The following communications have been received from non-resident members :—

A. MICHAELIS, "*On the* As *and* P *Derivatives of Benzine.*" By the action of chlorine on diphenyl-arsen-chloride, $(C_6H_5)_2AsCl$, several chlorine additive products have been obtained. Phenyl-arsen-chloride, $C_6H_5.AsCl_2$, yields, on treatment with Na_2CO_3, the compound $C_6H_5.AsO$, from which an oxychloride, $C_6H_5.AsCl_2O$, has been prepared, and an acid, $C_6H_5.AsO_2H$. The oxide gives, with bromine, $C_6H_5.AsBr_2$, and a compound, $C_6H_5.AsO_2$, analogous to $C_6H_5NO_2$, has been obtained. The chloride yields, with $(C_2H_5)_2Zn$, $C_6H_5As(C_2H_5)_2$. Higher chlorine derivatives of $(C_6H_5)_2PCl$ have also been obtained. $C_6H_5.PCl_2$, by heating in sealed tubes at a high temperature, is decomposed as follows :—

$$2C_6H_5.PCl_2 = PCl_3 + (C_6H_5)_2PCl.$$

E. ERLENMEYER is of the opinion that the "*Constitution of the Radical* C_3H_5 *in Eugenol*" should be expressed by $-CH_2-CH=CH_2$, and not by $-CH=CH-CH_3$, which he previously advocated.

F. HERRMANN has found among "*The Decomposition Products of Succinyl-Succinic Ether*," in addition to the hydroquinon and hydroquinon-dicarbonic acid previously described by him, also salicylic acid, the formation of which is not easy to explain.

G. GOLDSCHMIDT and G. CIAMICIAN, "*On a New Method of Determining Specific Densities.*" Some slight improvements are made upon the system of determining volumes by the weight of the mercury expelled from the apparatus after the substance enters into the gaseous state—which Victor Meyer first proposed.

P. LAGERMARK has found the "*Action of Sulphuric Acid on Acetylen*" to result in the formation of croton-aldehyd, aldehyd being probably the intermediary product.

O. WITT describes his discovery of the colouring-matter "*Chrysoidin*," lately investigated by A. W. Hofmann (CHEM. NEWS, vol. xxxv., p. 64), and explains his reasons for refraining from publishing the account of it. By treatment with CH_3I and C_6H_5I, he has succeeded in substituting in each case two hydrocarbon groups into the chrysoidin molecule. By a more complicated reaction four methyl groups have been introduced. With sulphuric acid he has obtained a sulphonic acid, $C_{12}H_{12}N_4.SO_3H$. The action of other acids, aqueous vapour, &c., are mentioned, none of the reactions, however, yielding noteworthy results.

W. F. HILDEBRAND and R. FITTIG, "*On the Constitution of Quinic Acid.*" The ethylic ether of quinic acid was exposed for a long time to the action of acetic anhydride, and yielded a fine crystalline substance, ethylic-tetracetyl-quinic acid, $C_6H_7(O.C_2H_3O)_4COOC_2H_5$, melting at 135°, and subliming without suffering decomposition. Quinic acid was further exposed to the action of HBr in sealed tubes at 130°, and was decomposed into benzoic acid and protocatechuic acid,—

$$2C_6H_7(OH)_4COOH = C_6H_5COOH + C_6H_3(OH)_2COOH + 6H_2O,$$

a reaction similar to that taking place with mucic acid. These two reactions show that quinic acid is to be considered as the monobasic, pentatomic acid of hexa-hydrobenzene.

A. BANTLIN finds that by the "*Action of Concentrated* HNO_3 *on Meta-nitro-phenol*," as well as on the two isomeric dinitro-phenols, styphnic acid (trinitro-resorcin) is produced.

M. TRAUBE, in the course of a study "*On Alcoholic Ferments in Media free from Oxygen*" has obtained results confirmatory of Pasteur's experiments, showing that there are organisms which can exist without oxygen, but refuting Pasteur's opinion that the necessary oxygen is derived from the sugar used in the experiments. Their existence is found to depend on the albuminous nourishment present.

R. FITTIG, "*On the so-called Non-saturated Compounds.*" Oil of camomile yields, by distillation, isobutyric acid, angelic acid, and tiglic acid, the latter two being divided by means of the calcium salt. The additive compounds of these two acids with Br_2 and BrH have also been examined, and in both cases they yield identical bodies, offering a somewhat remarkable case of isomery.

A. LANDOLT and R. FITTIG, "*On the Relations between Fumaric Acid and Maleic Acid, and between Citraconic Acid and Mesaconic Acid.*" The authors have ascertained that each pair of acids yields, with bromine, two distinct derivatives, while the additive compounds formed with hydrogen and hydrogen acids are identical. These facts are, however, consistent with the adoption of the formulæ HOOC.C.CH_2.COOH, and HOOC.CH.CH.COOH for fumaric acid and maleic acid, and corresponding formulæ for the other two.

F. BINDER, "*Additive Derivatives of Cinnamic Acid.*" Two of these compounds yield interesting reactions. Hydrobromo-cinnamic acid and hydriodo-cinnamic acid are changed chiefly into phenylic lactic acid, on boiling with water. Treatment with Na_2CO_3 changes the acids almost completely into styrol,—

$$C_6H_5.CH_2.CHBrCOONa = C_6H_5.CH_2.CH + NaBr + CO_2.$$

O. KRAFFT, by heating terpenylic acid, has obtained a "*Teracrylic Acid*," $C_7H_{12}O_2$, homologous with pyroterebic acid. It is a colourless liquid, boiling at 216°. In addition to terebic acid and terpenylic acid, the author has obtained another new acid by the oxidation of turpentine oil, which crystallises finely and melts at 163°.

P. GRIESS, "*Researches on Diazo Compounds.*" The author describes the property of diazo bodies of forming peculiar double compounds with tertiary amines. These derivatives are all strong colouring-matters, and differ so entirely from the compounds with primary and secondary amines, in physical and chemical properties, that an entirely different structure is ascribed to them. Azo-benzene-diethyl-amido-benzoic acid is deposited at once in the form of large red crystals, when a solution of diazo-benzene nitrate is poured into a cold solution of meta-diethyl-amido-benzoic acid. It possesses acid properties, and corresponds to the formula—

$$C_6H_5.N.N.C_6H_3(C_2H_5)_2N.COOH.$$

Several analogous compounds, containing substituted methyl groups, sulphonic groups, &c., are described. Theoretical considerations on the constitution of the compounds derived from the union of diazo bodies with primary and secondary amines follow.

P. P. BEDSON finds that, by the action of HNO_3 on para-bromo-phenyl-acetic acid, "*Two Isomeric Bromo-nitro-phenyl-acetic Acids*" result. They are easily separated by means of the varied solubilities of the salts. By oxidation to a known bromo-nitro-benzoic acid, one is shown to be para-bromo-phenyl-acetic acid; the other para-bromo-ortho-nitro-phenyl-acetic acid, is entirely decomposed by oxidising agents.

R. GNEHM and K. FORRER prepare a "*Toluen-disulphonic Acid*" by introducing small portions of toluen gradually into a flask in which solid sulphuric acid is in the melted condition, and then maintaining the temperature at 180° for two hours. It is identical with the α-disulphonic acid obtained by Senhofer in closed tubes, by the action of sulphuric acid and phosphoric acid on toluen.

L. MEDICUS, "*On Glyoxalyl Carbamid.*" The author shows the formula previously proposed for this body to be correct, by the quantitative determination of the decomposition products resulting from the action of KOH, and regards glyoxalyl carbamid as identical with allanturic acid and santanuric acid.

A. ATTERBERG, "*On α-Derivatives of Naphthalen.*" The author communicates some confirmatory proofs to his previous researches in this direction (CHEM. NEWS, vol. xxxiv., p. 270). The two Cl atoms in β-dichloro-naphthalen are shown to be in the same half of the naphthalen molecule by the formation of α-dichloro-phthalic acid, through the action of HNO_3. By the same treatment the two Cl atoms in γ-dichloro-naphthalin are found to be in separate halves of the molecule. The author deduces, from his investigations on the dichloro-naphthalens, additional evidence for the symmetrical form of the naphthalen molecule.

A. CLAUS and G. STEIN have obtained, by the "*Action of Sodium on Epichlorhydrin*," an alcohol, $C_6H_{10}O_2$, forming additive compounds with Br and HCl. The authors find, also, that the small yield of epichlorhydrin, by the treatment of dichlorhydrin with caustic alkalies, is due to the regeneration of glycerin during the process, half of the substance employed undergoing this change.

A. CLAUS and H. POPPE, "*On Melitic Acid.*" This is easily obtained pure in large quantities, direct from melite, by digesting the finely-pulverised mineral for several hours with concentrated ammonia. The filtered solution is evaporated to dryness and heated to 130°, at which temperature the humates are decomposed or changed into insoluble forms. The aqueous extract of the residue forms a colourless solution of pure ammonium mellitate, from which the acid is obtained by the usual method with Pb and H_2S. The authors find it impossible, by the action of Zn and C_2H_5I on the ethylic ether, to reduce one of the carboxyl groups to $-C(OH)(C_2H_5)_2$, as is the case with oxalic ether. Oxalic acid appears to stand alone in this respect among dibasic acids. A great similarity is noticed between the hexabasic mellitic acid and the tribasic phosphoric acid. Several acid and double mellitates analogous to the phosphates have been prepared.

A. LADENBURG responds to the recent criticisms of V. Meyer on his researches "*On Ammonium Compounds*" (CHEM. NEWS, vol. xxxv., p. 104), adducing proof to show the purity of his substances and the differences between the isomeric substituted ammonium compounds obtained by him.

University College School.—A large and influential committee has been formed for the purpose of raising a Testimonial to Mr. E. R. Horton, to be presented on the completion of the 11th year of his Vice-Mastership at University College School. A considerable sum has been already received, and it is hoped that the List of Subscribers may be yet largely aumented.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

MARCH, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Anhydride. Sulphuric	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Turbid	0·001	0·008	0·195	0·053	22·90	9·180	0·720	0·94	1·740	13·7	4·2
West Middlesex	Turbid	0·001	0·006	0·168	0·073	21·40	9·290	0·500	0·94	1·360	14·3	3·6
Southwark and Vauxhall	Clear	0·001	0·007	0·198	0·071	20·50	9·070	0·430	0·87	2·120	14·3	3·6
Chelsea	Clear	0·000	0·008	0·165	0·054	21·20	8·740	0·460	0·87	1·740	14·3	3·0
Lambeth	Turbid	0·000	0·009	0·186	0·070	22·10	9·010	0·680	0·94	2·060	13·7	4·2
Other Companies.												
Kent	Clear	0·000	0·002	0·375	0·007	30·10	12·040	0·860	1·51	3·360	18·8	4·6
New River	Clear	0·000	0·006	0·168	0·066	21·20	9·240	0·540	0·79	1·330	14·8	4·2
East London	Clear	0·000	0·006	0·150	0·070	22·50	9·408	0·648	0·94	1·900	13·7	4·2

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

CORRESPONDENCE.

OPENINGS FOR YOUNG CHEMISTS IN THE COLONIES.

To the Editor of the Chemical News.

SIR,—If you will kindly allow me space in your next impression I should very much like to ask the opinion of any of your readers as to the likely prospects of getting work for a young analyst in the colonies, more especially in New Zealand or Australia, connected with iron making or other metallurgical undertakings.—I am, &c.,

April 11, 1877.

COLONIST.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 14, April 2, 1877.

Experimental Researches on the Natural Sulphides.—M. Stan. Meunier.—Numerous experiments, the results of which were submitted to the Academy, prove that the native sulphides, if brought in contact with metallic solutions, suitably selected, effect the reduction of the dissolved metal. Thus galena, if placed in a solution of auric chloride, is immediately gilded over; in nitrate of silver it is quickly covered with very elegant metallic vegetation, resembling the "Arbor Dianæ;" mercury is also precipitated under the same conditions. The reaction in the first case is expressed by—$3PbS+Au_2Cl_3=3PbCl+2Au+3S$. In the second case by—$PbS+AgO,NO_5=PbO,NO_5+Ag+S$. All the sulphides examined—iron pyrites, copper pyrites, blende, cinnabar, stibene, and even sodium monosulphide (so commonly met with in mineral waters)—give rise to analogous precipitations. Certain selenides, antimonides, arsenides, and tellurides also behave in an analogous manner. The facts point to certain geological consequences, especially as regards the "mineralogical associations" so often remarked in metallic veins. If a vein of galena receives infiltrations of sea-water, always argentiferous, all the silver present will be seized and concentrated by the galena. Native silver is present in certain galenas, and we have thus an explanation of its origin. Further, the free silver, being very finely subdivided, will be exceedingly susceptible of combining with sulphur, which shows us the possible formation of argentiferous galenas. Simultaneously with the reduction of the silver a certain proportion of sulphur is set free. This is found in certain super-sulphuretted galenas, sometimes so rich in sulphur as to burn on contact with a flame. The sulphur liberated will rarely remain long in the free state; often it must combine with the silver.

Theory of Frigorific Machines.—M. A. Terquem.—A mathematical paper, incapable of useful abstraction.

Researches on the Metallic Reflection of Dark and Polarised Heat-rays.—M. Mouton.—This paper, also, is not suitable for abstraction.

Sulphide of Manganese.—MM. P. de Clermont and H. Guiot.—The conversion of the flesh-coloured sulphide of manganese into the green modification has already engaged the attention of several chemists. The authors find that at 305°, in presence of a small quantity of water, the red sulphide is partly converted into the green form. The green sulphide does not, as some have supposed, appear to be an oxysulphide. The authors have not been able to verify the statement of Geuther that the change of colour can be effected by congelation.

Reply to the Remarks of M. E. Chevreul concerning the Phosphorescence of Organic Bodies.—M. Radziszewski.—The author points out that he has examined the subject from a point of view differing from that under which M. Chevreul's researches were conducted.

Bulletin de la Societe Chimique de Paris, No. 4, February 20, 1877.

Products Formed by Calcining the Dregs of Beet-root Molasses in Close Vessels.—M. Camille Vincent.—Already noticed.

Wines Sophisticated with Magenta.—M. S. Cotton.—The author having twice been unable to detect magenta

in wines containing it, points out the necessity of examining the dregs rather than the clear liquid. He filters the wine, and when the filter is drained he places the paper with the deposit in the original bottle, and operates upon it with ether, ammonia, and acetic acid in the usual manner.

Analysis of Pyrogenous Gases.—M. Berthelot.—Already noticed.

Can Ozone Combine with Free Nitrogen in Presence of Alkalies, forming Nitrous Compounds and Nitrates?—M. Berthelot.—The author has not succeeded in proving the oxidation of free nitrogen by ozone in presence of alkalies.

Memoir on the Ferrocyanides.—M. Wyrouroff (*Ann. de Chim. et de Phys.*, viii., 444 to 486).—In the analysis of these compounds the metal was generally precipitated by an alkali; iron was determined volumetrically by permanganate of potassa. Most of the metallic ferrocyanides have been formed and examined.

Depositing Cobalt upon Metals.—M. R. Bœttger (*Chem. Centralblatt*, vii., 640).—By the use of two Bunsen elements a brilliant deposit of metallic cobalt was obtained upon brass or copper. The salt employed was the double chloride of ammonium and cobalt.

Nickelisation and Cobaltisation of Iron and Steel—M. F. Stolba.—Nickel may be deposited upon iron or steel without the aid of the battery by immersing the objects in a solution of zinc chloride and a salt of nickel, raising to a boil, and bringing the metal to be coated in contact with metallic zinc. A deposit of cobalt may be obtained by an analogous procedure.

Fusion of Nickel and Cobalt.—M. C. Winkler (*Dingler's Journal*, ccxxii., p. 175).—The author has obtained both these metals in ingots of from 2 to 5 kilos. The conditions required are a sufficiently high temperature, the use of refractory crucibles, the absence of carbon and silicon in contact with the melted metal, and protection from atmospheric oxygen during casting.

Use of Nitrite of Soda as an "Antichlore."—M. C. Lieber (*Dingler's Journal*, ccxxi., p. 250).—The author objects to hyposulphite of soda that it leaves finely-divided sulphur among the fibre, which, if not perfectly removed, may become oxidised to sulphuric acid and damage the goods.

Reimann's Färber Zeitung,
No. 15, 1877.

This issue contains nothing of general interest.

MEETINGS FOR THE WEEK.

MONDAY, April 23rd.—Medical, 8.
—— Royal Geographical, 8.30.
—— Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.

TUESDAY, 24th.—Civil Engineers, 8.
—— Royal Institution, 3. "Chemistry of the Heavenly Bodies," Prof. Gladstone.
—— Society of Arts, 8, (African Section). "The Trade and Resources of Morocco," Dr. Arthur Leared.

WEDNESDAY, 25th.—Society of Arts, 8. "Deaf not Dumb," Mr. B. St. John Ackers.
—— Geological, 8.
—— London Institution, 12. (Anniversary).

THURSDAY, 26th.—Royal, 8.30.
—— Society of Arts, 8. (Chemical Section). "Phosphor-Bronze and its Applications," Mr. Alexander Dick.
—— Royal Institution, 3. "Heat," Prof. Tyndall.
—— Royal Society Club, 6.30.

FRIDAY, 27th.—Royal Institution, 9. "On Arctic Life," Dr. John Rae, M.R.I. (instead of Lieut.-Gen. Strachey, whose Discourse is postponed).
—— Quekett Club, 8.

SATURDAY, 28th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.
—— Physical

ERRATA—P. 151, col. 1, line 11 from top, *for* "chromium" *read* "chromeisen." Line 13 from bottom, omit second "10 c.c.," and insert "$K_2Cr_2O_7$."

THE
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THE CHEMICAL NEWS.

VOL. XXXV. No. 909.

ON THE NEW METAL—GALLIUM.*

By M. LECOQ DE BOISBAUDRAN.

(Concluded from p. 160.)

VI. SALTS OF GALLIUM.

THE 10 centigrms. of pure gallium obtained at the end of April, 1876, were almost immediately sacrificed in trying to determine the equivalent, for which, moreover, I have not yet found numbers sufficiently concordant. It has, therefore, been impossible for me at present to utilise, in the preparation of its compounds, those relatively large quantities of gallium which I have obtained. I have only employed for this purpose the few milligrms. of the new metal produced from the earliest operations,† so I shall only describe, and that very summarily, a small number of gallium salts. All the compounds of gallium which I have examined are colourless.

1. *Chloride.*—Chloride of gallium is very soluble in water, and deliquescent. If its solution is evaporated and carefully dried, the residue attracts moisture from the air and liquefies. The syrupy solution thus obtained is clear, and does not become turbid if diluted with a *very small* quantity of cold water. A larger quantity of water, however, causes the formation of a copious white precipitate (doubtless an oxychloride) which falls quickly to the bottom of the vessel, and which dissolves only slowly in dilute hydrochloric acid in the cold, but more rapidly by the aid of heat. In researches on gallium this property must be borne in mind, otherwise there is a risk of the rare metal being left in the residues precipitated in the cold by weak hydrochloric acid. In order to extract all the gallium from an insoluble product the latter must be boiled with water strongly acidulated with hydrochloric acid. In my earlier researches I often failed to detect the presence of the new metal in consequence of the great difficulty in separating it from the masses of insoluble residues with which it had become incorporated. If a *very small* quantity of hydrochloric acid is added to some dried chloride of gallium the latter is dissolved in cold water; this dilute solution becomes turbid when hot, and grows clear again on cooling. If a slightly acid solution of chloride of gallium is dried at a gentle heat it yields crystalline needles and leaflets, which act strongly upon polarised light.

2. *Sulphate.*—This salt is very soluble in water. The concentrated solution is syrupy. It is not deliquescent. When very neutral it decomposes on boiling; very little gallium remains in the liquid provided the latter is sufficiently dilute. When cold the precipitate is completely re-dissolved. Sulphate of gallium is soluble in alcohol at 60 per cent. It is insoluble in ether. By slow evaporation, or on the cooling of a concentrated solution, it crystallises in the form of leaflets, soft to the touch, having a pearly appearance, and being sometimes grouped in stars or shining masses. If evaporated and dried until the evolution of white sulphuric vapours almost ceases, an acid sulphate of gallium does not lose its solubility in water nor in weak alcohol; a certain time is, however, required for the completion of the solution.

3. *Alum.*—I have obtained a well crystallised salt, which to all appearance is ammonio-gallic alum. The quantity at my disposal has not been sufficient to enable me to analyse it nor to measure its angles, but its characteristics are sufficiently distinct for its nature to be determined. This salt has been prepared by neutralising with ammonia an acid solution of sulphate of gallium, and allowing the liquid to evaporate slowly. There could not be in it any other alkalies than ammonia and traces of soda. The alumina ought to have been separated by repeated treatments with sulphuretted hydrogen in the presence of acid acetate of ammonia and salts of zinc.

The following facts relate to the small crystals presented to the Académie des Sciences on December 6, 1875:—

Gallium alum is colourless and limpid. It is soluble in cold water and in weak alcohol. A concentrated solution becomes slightly turbid on boiling, and clears completely on cooling. When the solution is very dilute the boiling causes the formation of an abundant white precipitate; this is probably a basic salt. If filtered when hot only traces of gallium remain in the liquid. The precipitate may then be washed over the filter, at first with boiling, then with cold water, without sensible loss of gallium, but if it is left in contact with the mother-liquor it is completely re-dissolved when cooling. The dilute solution of gallium alum does not become turbid on boiling if a little sulphuric acid is added. A certain quantity of acetic acid produces the same effect; doubtless an equilibrium is then maintained between the acetate and the sulphate of ammonia, and the small portion of sulphuric acid set at liberty holds the sulphate of gallium in solution. Unlike acid acetate of ammonia, gallium alum behaves itself with heat and in the cold exactly like the neutral sulphate.

Gallium alum crystallises into cubes having octahedric faces, and into octahedra with cubic faces. These crystals present exactly the aspect of common alum; their solution, if slowly evaporated, behaves under the microscope just like the known alums. Placed between two Nicol prisms gallium alum does not act upon polarised light. With respect to the phenomena of supersaturation gallium alum behaves as a veritable isomorph of the other alums.

A small crystal was kept for some time under a layer of water, in order to deprive it of the crystalline germs attached to its surface. It was afterwards laid in a slightly supersaturated solution of alumino-ammoniacal alum. It grew immediately therein, and determined the crystallisation of the liquid.

I have recently proved that gallium alum is produced when solutions of sulphates of ammonia and pure gallium are mixed. If protected from atmospheric dust the liquid remains clear, but it crystallises as soon as it comes in contact with a trace of common alum. A supersaturated solution is equally well obtained if slightly acid gallium alum is concentrated in the heat. If, as seems certain, there is no error in the nature of my gallium alum and ammonia, the existence of this combination fixes the atomicity of the new element, and attributes to its oxide the same chemical function as that of alumina. The oxide of gallium will, then, be described as Ga_2O_3, and the chloride probably Ga_2Cl_6. Besides, all the properties above described agree in classifying the oxide of gallium among the sesqui-oxides. Up to the present time I have observed nothing which indicates several degrees of oxidation of gallium.

VII. EXTRACTION AND PURIFICATION OF GALLIUM.

As soon as the principal chemical characteristics of the new element were known to me, I tried to discover the most economical and rapid method of extracting and purifying it.

The following is the method I adopted for the treatment of several hundred kilogrammes of raw material:—The crude blende, reduced to powder, is dissolved by the aid of heat in *aqua regia*, containing 4 or 5 parts of hydrochloric acid to 1 of nitric acid.* An excess of *aqua regia* and an excess of blende are alternately added, so as not to leave any nitric acid in the final liquid, whilst the ore is completely attacked.

* Communicated by the Author.

† It is quite recently that I have obtained the 65 centigrammes mentioned on page 150.

* In working with zincs tutty, or carbonated calamines, hydrochloric acid will be sufficient.

In the filtered acid solution pieces of sheet-zinc are placed. A metallic sponge is deposited (Cu, As, Pb, Cd, In, Tl, Hg, Se, Ag, Bi, Sn, Sb, Au, &c.). The solution is filtered when the escape of hydrogen has greatly subsided, though yet perceptible. The liquid which contains the gallium is poured into receivers (or into carboys placed over a water-bath). A large excess of zinc is then added to it, and it is heated for six, twelve, or twenty-four hours, according to the temperatures attained. A gelatinous precipitate (not adhering to the sheets of zinc) is formed. This is collected on filters, and is found to contain alumina, sub-salts of zinc, often silica, cobalt, chromium, &c., and also a little of the metals reducible with zinc and gallium.

In order to ascertain that the boiling has been sufficiently prolonged, a sample of the liquor is filtered, and one-fifth of its volume of water is added; spring- or river-water is very suitable for this purpose, on account of the calcareous bicarbonate which it ordinarily contains. If the liquid becomes notably turbid the boiling is sufficient. From one-fourth to one-third of its volume of the same common water is then added before the liquid is transferred to the filters.

Unless the ore is very rich the hydrochloric solution of this first precipitate does not give the gallium rays in the spectroscope. However that may be, the deposit, well washed, is re-dissolved in hydrochloric acid, and the new liquid treated with zinc exactly in the same manner as the first solution was with aqua regia. Although the ore may be very poor, the second gelatinous precipitate will give the gallium rays.

The treatment with metallic zinc may now end, but time is gained, without any sensible loss of gallium, by repeating the operation a third time. It is, however, useless to push any further the elimination of the zinc.

The last gelatinous precipitate is dissolved with hydrochloric acid; it is evaporated to expel the great excess of acid, a small portion of which must, however, remain free. The liquor is diluted with distilled water, and a current of sulphuretted hydrogen is passed into it. It is filtered, acetate of ammonia and acetic acid are added, and it is then gain treated with sulphuretted hydrogen.

If there is much zinc and very little gallium, the latter is carried down effectually with sulphide of zinc. The spectroscope indicates whether any gallium remains in the last fractions of sulphide of zinc.

If the ray Gaα 417·0 is still visible in the spectrum of the hydrochloric solution of the last sulphide, a neutral salt of zinc is added, and the treatment with sulphuretted hydrogen and acid acetate of ammonia is renewed. It ends by insignificant traces only of gallium remaining in the liquid.

It is well not to continue the treatment with sulphuretted hydrogen after all the zinc has been precipitated, as to avoid the formation of sulphide of cobalt, which would contaminate the product.

The sulphides are carefully washed with a dilute solution of acetate of ammonia, charged with sulphuretted hydrogen, and to which a little acid acetate is added; they are afterwards dissolved in hydrochloric acid, and the treatment with sulphuretted hydrogen and acid acetate of ammonia is repeated.

The hydrochloric solution of the sulphides (deprived of sulphuretted hydrogen by boiling and by the addition of a few drops of nitric acid) is precipitated with carbonate of soda in the cold,* care being taken to fractionate the precipitates.

The gallium is rapidly concentrated in the first deposits, whose total disappearance is rather sudden, as indicated by a neutral reaction. I shall designate the hydrochloric solution of the first precipitates formed by carbonate of soda as *impure chloride of gallium*. Hitherto I have been unable to unite in a small volume all the gallium contained in the ore.

* Of neutral salts of gallium when boiled with a solution precipitating by carbonate of soda whilst hot, for the precipitate re-dissolved while cooling.

In the preparation of pure metallic gallium the principal point to be aimed at is the removal of all foreign bodies, even at the risk of carrying off at the same time a small portion of gallium, which, however, is afterwards worked up.

The *impure chloride of gallium* is treated in the cold with sheets of zinc; the contact must be continued till the liquor begins to be rendered turbid by sulphuretted hydrogen. The greater part of the indium, thallium, cadmium, and lead, as well as sensible traces of gallium, are then precipitated on the zinc plates and are separated by filtration.

A current of sulphuretted hydrogen is passed into the liquid. A little sulphide of zinc is separated, carrying away with it the remaining portions of the indium, cadmium, and lead, and also a small quantity of gallium. The solution is filtered, acetate of ammonia with excess of acetic acid is added, and it is treated with sulphuretted hydrogen, &c., as before mentioned. If necessary, a neutral salt of pure zinc is added.

In the hydrochloric solution of the sulphides gallium is precipitated fractionally with carbonate of soda. The deposits found by the spectroscope to be poor in gallium are thrown on one side. By repeating this operation a second time the whole of the zinc and cobalt is separated. Towards the end of the treatment sulphuric and not hydrochloric acid must be employed, as the presence of the latter would be injurious during the electrolysis.

The purification is completed by treating once or twice with ammonia in excess. A *great deal* of gallium remains in the ammoniacal liquid; this is not added to the other gallium products, but is treated separately. It is better to let it boil till the free ammonia is almost entirely expelled. The gallium is deposited together with zinc and other metals; this deposit is re-dissolved with sulphuric acid, and treated afresh with ammonia. In this way an important supply of oxide of gallium purified with ammonia is obtained. A second operation likewise furnishes a weaker supply of the same oxide.

The liquids charged with ammoniacal salts are united and boiled with aqua regia; the residue, tolerably rich in gallium, re-enters into the operation.

The pure oxide of gallium* is dissolved in caustic potassa. The electrolysed solution causes the gallium to be deposited in a liquid state† on the sheet of platinum,‡ serving for the negative pole.

The surface of the positive electrode (platinum) should be 2, 4, 6, or 10 times larger than that of the negative electrode. The ratio of the polar surfaces is regulated according to the power of the battery and the concentration of the liquid. To electrolyse 20 or 30 c.c. of solution five or six Bunsen elements are sufficient. Even with a stronger battery it takes a long time to extract by means of electrolysis all the gallium contained in the liquid.

Electrolytic gallium covers the negative electrode with an adhesive layer, which may, however, be detached when it has acquired a notable thickness, by bending the sheet of platinum in cold water, after the gallium has solidified. The gallium is isolated more easily still by pressing the sheet of platinum between the fingers in warm water.

I have recently simplified and greatly shortened the process of extracting pure gallium by working as follows:—

1. The ore, according to its nature, is dissolved in aqua

* The electrolysis must also help to contribute to the separation of the last traces of aluminium from the gallium, for I have ascertained with certainty that the electrolysis of a solution of alumino-ammoniacal alum in caustic potassa does not lead to the reduction of metallic aluminium on the negative electrode under the conditions by which gallium is readily isolated. If any traces of aluminium were reduced at the same time with the gallium, it could only be by an effect of *entrainement*, which, moreover, has never been brought under my notice.

† The passage of the voltaic current heats the solution so strongly that the vessel has to be surrounded with cold water.

‡ I have tried to reduce the gallium on a plumbago electrode, but that substance, being porous, absorbed the liquid metal.

regia, hydrochloric, or sulphuric acid. The liquid is treated with zinc and heated; this operation is repeated a second time, as before stated. A current of sulphuretted hydrogen is passed into the hydrochloric solution of the second precipitate formed by the zinc; it is filtered, and the sulphuretted hydrogen is driven off. It is fractionated with carbonate of soda, ceasing when the ray Gaα 417·0 ceases to be visible in the hydrochloric solution of the precipitate.

3. The oxides (or sub-salts) are taken up with sulphuric acid; the solution is carefully evaporated until white sulphuric acid vapours are no longer, or but slightly, given off. It is allowed to cool, and is then stirred with water, which dissolves the mass after the lapse of a time varying from a few hours to a couple of days. If there are any portions rendered insoluble by too strong calcination, they are treated with sulphuric acid and evaporated again to dryness. The solution of the sulphate, almost neutral, is diluted with a great deal of water and boiled. The sub-salt of gallium is separated by filtration *when hot*. If the evaporation to dryness has not been carried far enough to drive off nearly all the free sulphuric acid, little or no deposit will be formed during the boiling of the dilute solution of the sulphate. In this case the evaporation must be repeated and the desiccation pushed a little further.

4. The sub-salt precipitated by boiling is dissolved in a little sulphuric acid, and a slight excess of caustic potassa is added, so as to re-dissolve the gallium but to leave the iron. A prolonged current of carbonic acid gas precipitates the oxide of gallium.

5. This oxide is re-dissolved with a minimum of sulphuric acid; an excess of slightly acid acetate of ammonia is added,* and then sulphuretted hydrogen is passed into it.

6. The acetic liquor is diluted with water and boiled. The greater part of the gallium is precipitated. It is filtered whilst hot and washed with boiling water. The mother-liquor, concentrated, and boiled with aqua regia in order to destroy ammoniacal salts, is added to the other gallium residues.

7. The precipitate formed on heating the acetic acid is re-dissolved in sulphuric acid; a slight excess of caustic potassa is added, and it is filtered.

8. The potassic solution is then electrolysed.

The different residues proceeding from these manipulations can be added to the first gelatinous precipitates formed by the zinc (operation No. 1). It is better, however, to treat them separately: first, by fractionation with carbonate of soda to separate the greater part of the zinc, cobalt, &c., then by caustic potassa to carry down the iron. The product is then added to that resulting from operation No. 2.

If a residue is obtained containing little gallium and much iron, the most simple method is to treat with zinc by the aid of heat, protecting it from the air; the greater part of the iron will remain in solution.

A residue very rich in alumina and very poor in gallium would be treated either by ammonia in excess, taking care to repeat the operation, or by sulphuretted hydrogen, in presence of acetate of ammonia and a zinc salt.

The gallium obtained by the above-described methods seems to be very pure. It may, however, still contain minute traces of foreign metals, especially of iron. It may be brought to a great state of purity by immersing it for about half an hour at a temperature of from 60° to 70° in nitric acid (*very free from chlorine*) diluted with its own volume of water. The melted metal is washed and the globules are easily united under warm water. The loss of gallium is not very considerable.

VIII. Relative Richness of Gallium Ores.

It may be very useful to those chemists who wish to prepare gallium if I give here some indications of the relative richness of the raw materials that I have examined.

In the following list the substances are arranged according to their richness in gallium, beginning with the richest.

Rich Substances.

1. *Black Blende from Bensberg (Rhine)* sent by the Vieille-Montagne Mining Company (mines: Apfel, and Lüdrich, Galerie Frazisca). This is the richest ore I have yet met with. The blende from the mine Lüdrich seems to me rather superior to that of Apfel.

2. *Yellow Transparent Blende from Asturias.*—Seems to be of intermediate richness between the blendes of Bensberg and of Pierrefitte. It contains sensible quantities of mercury.

3. *Brown Blende from Pierrefitte.*—(Vallée d'Argelis). Notably less rich than the Bensberg blende, but considerably more so than the following substances:—

Rather Poor Substances.

4. *Zinc in Powder and in Grains (Tutty).*—Bought at Cognac at a house-painter's, and coming from the mines of the Vieille Montagne. Contains very sensible traces of gallium.

5. *Cadmies from Corphalie.*—Contain sensible traces of gallium. The portion of these sublimates which is not acted upon by hydrochloric acid yields with boiling sulphuric acid traces of gallium much less weaker than those which are first removed by hydrochloric acid.

Very Poor Substances.

6. *Zinc Dross* (a mixture of metallic zinc and oxide of zinc).—Used for the manufacture of sulphate of zinc in the Javel Works (Paris). Contains traces of gallium.

7. *Yellow Blende, slightly Brownish, Opaque,* from Mandesse (Gard).*—Shows rather feeble traces of gallium.

8. *Brown Blende from Sweden* (sent by the Vieille Montagne Mining Company).—Gives feeble traces of gallium.

9. *Black-brown Blende from Schwarzenberg (Saxony).*—Rich in indium, but containing only feeble traces of gallium.

10. *Blende in Rods from Nouvelle-Montagne* with calcareous gangue. Has furnished very weak traces of gallium.

Substances Giving no Appreciable Trace of Gallium.

Ribbon-blende from the Vieille-Montagne.
Galenas from Pierrefitte and elsewhere.
Tutty of Corphalie.
Laminated Zinc coming from the works of Vieille Montagne, and used at Cognac for building purposes.
Carbonated Calamines from Sardinia.—Two samples.
Carbonated Calamines from Le Gard.—Two samples.
Hydrochloric Acid of commerce.
Nitric Acid of commerce.

IX.

I cannot bring this memoir to a close without referring to the very interesting note which was published on the 22nd November, 1875, in the *Comptes Rendus* by M. Mendeleef relating to the classification of elementary bodies, to the prevision of unknown elements, and to the calculation of their probable properties.

Amongst the numerous hypothetical bodies whose existence is indicated by M. Mendeleef's ingenious classification there is one which, taking its calculated properties as a whole, seems to correspond to gallium, from which it differs, however, in some respects.

As frequently happens when two persons are occupied independently with analogous researches, the theories of the learned Russian physicist agree with mine on certain points, whilst they differ in others. At a future time I hope

* The sulphuric liquid should not be too acid, and care must be taken not to add too large a quantity of acid acetate of ammonia, or a notable part of the gallium will be left in the boiling acetic solution.

* Containing the geode covered with little yellow transparen crystals.

to return to M. Mendeleef's work by making known my own attempts at chemical classification. For the present I limit myself to the statement that the analogy between the spectra of aluminium, gallium, and indium struck me at the time of my first observations of the rays Gaα 417·0 and Gaβ 403·1. I immediately calculated the equivalent of the new metal by combining the application of my spectral laws (see *Comptes Rendus*, January 24, 1870, page 146, and May 2, 1870, page 977), with my theoretical ideas on the classification of the elements.

These remarks were communicated to M. Wurtz and other *savants*; but owing to the difficulty of clearly establishing the reactions and chemical functions of gallium with such rare and impure material as I at that time possessed, I thought it prudent to simply announce the *facts* which I had observed, reserving till a later period an exposition of my theoretical considerations.

I ought also to say that I was ignorant of the description given by M. Mendeleef of the properties of his hypothetical metal. I will even add that this ignorance may perhaps have been advantageous to me, for I should have experienced serious delays if I had been led to seek for gallium in the precipitates formed by ammonia, and not in the ammoniacal solutions in which it is entirely, or almost entirely, contained when it is in feeble quantity.

In fact, the properties of M. Mendeleef's hypothetical metal should "present the mean between those of aluminium and of indium." Now oxide of indium is considered to be almost insoluble in ammonia, a property which is utilised in its separation. As for alumina, its solubility in ammonia, though slight in presence of ammoniacal salts, is sensible.

As long as I possessed only a few milligrms. of impure compounds of gallium I admitted that the great delicacy of the spectral reactions and the extreme minuteness of the quantities upon which I operated might have caused me to over-estimate the relative solubility of oxide of gallium in ammonia to that of alumina; but more recent experiments have confirmed my first observations, in which I attributed to oxide of gallium a turbidity in ammonia greater than that of alumina.

We have seen (page 159) that on fractionated precipitation with carbonate of soda oxide of gallium seems to be precipitated before the alumina, and is certainly deposited before the oxide of indium. According to theoretical previsions the precipitation of oxide of gallium should be intermediate between the oxides of indium and alumina. It seems equally difficult to reconcile the extreme fusibility of gallium with the results obtained by theoretical calculations.

It will thus be seen that, notwithstanding the incontestable merit of M. Mendeleef's hypotheses, many reactions and qualities of the new metal differ sufficiently from those indicated by theory to have rendered the success of a research very problematical if it had been guided solely by that theory, and the ore employed had been very poor in gallium.

It seems to me probable, then, that without the particular experimental method which I followed neither M. Mendeleef's calculations nor my own hypothesis would for a long time have led to the discovery of gallium.

However, the discovery of the new metal gives to the classifications predicting the existence of unknown elements an importance which it was impossible, I think, to accord to them until they had been verified by some positive fact. I need not insist on the extreme interest which is particularly attached to the confirmation of M. Mendeleef's views concerning the density of gallium.

Now it is known that in mineral chemistry (as well as in organic chemistry) the natural classifications approach sufficiently near to the truth for the theoretical data derived from them to be afterwards utilised in science. A too absolute signification ought not always to be attributed to these hypotheses; but they should be employed as indications, a little vague perhaps, though *as a whole* sufficiently correct to form a reasonable basis for researches, especially for the institution of new experimental methods, the application of which rarely fails in leading to interesting results.—*Annales de Chimie et de Physique.*

CONTRIBUTIONS TO VOLUMETRIC ANALYSIS.

THIRD PAPER.—CORRECTION OF THE ERRORS DUE TO VARIATIONS OF TEMPERATURE.

By P. CASAMAJOR.

(Continued from p. 161.)

IN the preceding remarks we have, with a view of presenting the subject in its greatest simplicity, purposely omitted an element, which must now be taken in consideration. We have spoken of expansions, but have not specified whether they were absolute or relative to the expansion of glass. We may now say that the expansions we have given are the absolute expansions of water. As our object, however, is to discover the changes of volume due to variations of temperature as they occur in glass burettes, it is not the absolute expansion we need, but the relative expansion with regard to glass.

If a liquid is placed in a glass vessel, and the temperature increases or diminishes, if both the glass vessel and its contents remain at the same temperature, everything will take place exactly as if the dimensions of the glass vessel did not vary, and the expansion of the liquid was the difference between the expansion of the liquid and the expansion of glass. Now, the cubic expansion of glass is 0·000026, and it remains the same for all temperatures. Therefore, to obtain the total relative expansion of water at any temperature, starting from 15° as a normal, we must subtract from the total absolute expansion of water at that temperature, as given in the second column of Table No. III., as many times 0·000026 as the number representing the temperature is removed from 15°. At 16°, the relative expansion is then 0·000173 − 0·000026 = 0·000147; at 17°, the total relative expansion will be 0·000357 − 0·000052 = 0·000305, &c.

The numbers obtained in this way can be placed opposite to the numbers representing the corresponding total absolute expansions, and they will form the third column of Table No. III. By means of the numbers in this third column we may easily calculate the volume of liquid at 15° corresponding to any volume observed at any temperature. If we have used 35 c.c. of test solution at a temperature of 37° C., we will find the corresponding volume at 15° by noting that the total relative expansion from 15° to 37° is 0·005323, which means that 1 c.c. of water, in passing from 15° to 37°, becomes 1·005323 c.c.; therefore by dividing 35 c.c. by 1·005323, the quotient, 34·819 c.c., represents the volume at 15°, corresponding to 35 c.c. at 37°.

Instead of dividing 35 by 1·005323 the operation would be much simplified by multiplying by—

$$\frac{1}{1{\cdot}005323} = 0{\cdot}994705,$$

and a table might be formed in which, opposite to each degree of temperature, would be found a factor, by which to multiply the volume of test liquor used in an analysis.

I have, however, to propose a plan which is easier and more simple in practice, and which will be readily understood by referring to the curve drawn with a full black line in Fig. 1. If we suppose, as before, that the space between two vertical lines represents 1° C., and if we attribute to the space between two horizontal lines a value equal to 0·0001 c.c., as shown on the right of Fig. 1, we may mark on every vertical line, starting from the horizontal line marked 0, a distance equal to the number 0·0001 c.c., which represents the total relative expansions at the corresponding temperature. We may now connect all the points thus obtained by a curve. This, by referring

* Read before the American Chemical Society, December 7, 1876.

to Fig. 1, is the curve drawn with a full black line, which presents the appearance of an imperfect parabola with its apex at 6° C.* By referring to Fig. 1, we may notice that this curve intersects the horizontal lines corresponding to 0·0005, 0·001, 0·0015, 0·002, 0·0025, &c., at certain points, and that we may easily ascertain to what temperatures these points correspond. We will then find that—

−0·0005	corresponds to	9·9°	C.
0·000	,,	,, 15·0	,,
0·0005	,,	,, 18·2	,,
0·001	,,	,, 20·75	,,
0·0015	,,	,, 23·2	,,
0·002	,,	,, 25·3	,,
0·0025	,,	,, 27·3	,,
0·003	,,	,, 29·4	,,
0·0035	,,	,, 31·2	,,
0·004	,,	,, 32·8	,,
0·0045	,,	,, 34·5	,,
0·005	,,	,, 36·1	,,
0·0055	,,	,, 37·6	,,
0·006	,,	,, 38·8	,,
0·0065	,,	,, 40·4	,,
0·007	,,	,, 41·6	,,
0·0075	,,	,, 42·9	,,
0·008	,,	,, 44·2	,,
0·0083	,,	,, 45·0	,,

Now if we take a centigrade thermometer, ranging from 5° to 45°, and on one side of the column we mark the degrees of temperature, we may, on the other side, mark the places where 1 c.c. becomes 1·0005, 1·000, 0·0015, 1·002, &c. If we have made a volumetric analysis and used a certain volume of test solution at a known temperature, we will find, on the right of the thermometer, the number by which we must divide the volume of test solution to have its corresponding volume at 15°. If we have used 63 c.c. at a temperature of 35° C. we may note that the expansion marked on the scale on the right of the thermometer, which comes nearest to the required expansion is 1·0045, which corresponds to 34½°; and on dividing 63 by 1·0045 we will obtain 62·7 c.c.

Instead of dividing by the numbers which represent the expansions at various temperatures, we may, as before, multiply by a number representing unity divided by these expansions. We may mark these numbers on the thermometer as follows:—

At	9·9° Centigrade	1·0005
,,	15·0- ,,	1·000
,,	18·2 ,,	0·9995
,,	20·75 ,,	0·999
,,	23·2 ,,	0·9985
,,	25·3 ,,	0·998
,,	27·3 ,,	0·9975
,,	29·4 ,,	0·997
,,	31·2 ,,	0·9965
,,	32·8 ,,	0·996
,,	34·5 ,,	0·9955
,,	36·1 ,,	0·995
,,	37·6 ,,	0·9945
,,	38·8 ,,	0·994
,,	40·4 ,,	0·9935
,,	41·6 ,,	0·993
,,	42·9 ,,	0·9925
,,	44·2 ,,	0·992

In Fig. 2, I give a thermometer marked in this way. On the left are the degrees C., while on the right are the numbers by which we must multiply the reading of the burette to reduce them to the corresponding volumes at 15° C. If we have used 85 c.c. of a solution, and if the temperature is 32½° C. we will find that the nearest factor is 0·996, which corresponds to 32·8°. If we multiply 85 by 0·996 the product, 84·66 c.c., is the correct reading at 15°.

To be able to make use of the corrections afforded by the methods given above, it is necessary, in the first place, that our test-solutions should all be titrated at 15°. This can be easily done by using the data already given. Suppose we have weighed 6·3 grms. of pure dry crystallised oxalic acid and dissolved the whole quantity in water, this quantity of oxalic acid represents 100 c.c. of a titrated solution of oxalic acid containing 63 grms. to the litre. These 6·3 grms. of acid are capable of saturating exactly 100 c.c. of titrated solution of potassic hydrate, containing 56 grms. to the litre. If we have a solution of potassic hydrate of unknown strength, and we wish to discover the volume of it at 15°, which will be equivalent to 100 of the solution containing 56 grms. to the litre, we will proceed as follows:—

If we have used 110 c.c. of the potassa solution to saturate 6·3 grms. of oxalic acid, and if the temperature is 34° C., we may, by consulting the thermometer o Fig. 1, find that 0·9965 is the nearest factor on the scale, and if we multiply 110 by 0·9965, the product, 109·65 c.c., will give the volume at 15° C.

Fig. 2.

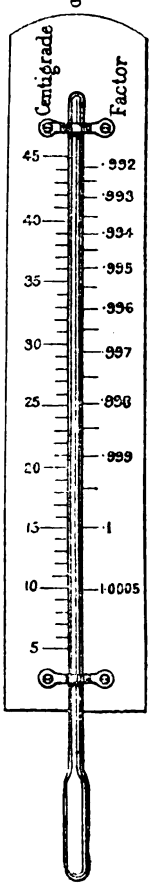
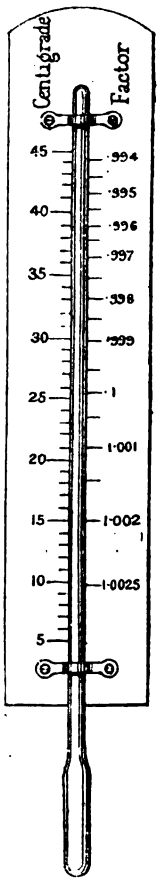


Fig. 3.



Although, in accordance with nearly universal usage, I have adopted 15° C. as the normal temperature, I have pointed out that 25° is nearer the average temperature of our laboratories. To those wishing to adopt 25°, or any other temperature, as a standard, the table marked No. 2 will afford all the necessary data. If they should desire to take 25° as the normal, and still wish to avoid the trouble of going over all the calculations, I would suggest that by adopting 25·3° as a normal; they can easily obtain the desired corrections by subtracting 0·002, which is

* The reason that the apex is at 6° instead of 5°, is that expansion for 1° at 5° is 0·000022 (see Table No. II.), which is less than 0·000026, the expansion of glass.

the expansion corresponding to 25·3°, from those already given. The expansions of 1 c.c. will then become :—

−0·0025	at 9·9°	Centigrade.
−0·002	,, 15·0	,,
−0·0015	,, 18·2	,,
−0·001	,, 20·75	,,
−0·0005	,, 23·2	,,
0·000	,, 25·3	,,
0·0005	,, 27·3	,,
0·001	,, 29·4	,,
0·0015	,, 31·2	,,
0·002	,, 32·8	,,
0·0025	,, 34·5	,,
0·003	,, 36·1	,,
0·0035	,, 37·6	,,
0·004	,, 38·8	,,
0·0045	,, 40·4	,,
0·005	,, 41·6	,,
0·0055	,, 42·9	,,
0·006	,, 44·2	,,
0·0063	,, 45·0	,,

From these numbers, by proceeding in the same manner as before, we may obtain a thermometric scale, in which 25·3° is the normal, and the factors on the right of the tube are arranged as in Fig. 3.

ON THE MANUFACTURE OF IODINE.

By E. C. C. STANFORD, F.C.S.

Although comparatively a small industry, the manufacture of iodine is peculiarly interesting here, as from the first it has been almost confined in Great Britain to this city. I have therefore been requested to compile a paper on the subject.

Iodine was discovered by Courtois in 1812, but it was not made here in quantity till about the year 1841. The imports of kelp in that year into Clyde amounted to 2565 tons: kelp was then used for soap-making, and the iodine was extracted from the leys of the soap-boilers. In 1845 there were four small works engaged in the manufacture of iodine, mostly using soap-leys. In 1846 these were increased to twenty, the majority lixiviating kelp direct. The imports of this material increased in 1845 to 6000 tons. Owing, however, to the remarkable fluctuations in the price of iodine, and the extremely variable character of the crude material or kelp employed, one maker after another gave up working it, and now there are only three makers of iodine in or near Glasgow.

The sudden fluctuations in the price of iodine, ranging from 4s. per lb. to 34s. per lb. (the extreme points reached), while the price of the raw material did not materially vary, have involved many manufacturers in heavy losses, the profits in high times having generally fallen to speculators, and the losses in low times to the manufacturers. The whole manufacture is so limited that it has afforded unusual temptations to speculators. The table below shows the imports of kelp into Clyde and the price of iodine for the last thirty-five years.

The lixiviation of kelp as at present practised here is a simple process. The kelp is broken up into pieces the size of road metal, and lixiviated in vats coupled and heated by steam, similar to those employed in the lixiviation of black-ash; the solution is run off at about 40° to 45° T. This is evaporated in ordinary open boiling-pans (9 feet diameter), and the salts which deposit are fished out. At about 62° T. a rough salt is deposited, consisting of 50 to 60 per cent of potassium sulphate, combined with sodium sulphate and chloride. The hot liquid is then run into iron coolers, generally cylindrical and of cast-iron, and a crop of potassium chloride crystallises out in about three days. The mother-liquor is again boiled down three times for good drift kelp, and after each boiling kelp salt is deposited and fished out, and the hot liquor is again run into the coolers, and another crop of potassium chloride obtained. These successive crops will range in strength from 80 per cent to 95 per cent of potassium chloride. The mother-liquor, having a density of 85° to 95° T., is then mixed with about one-seventh part of oil of vitriol, 145° T., and allowed to settle for twenty-four hours; the sulphurous compounds are decomposed, and sulphur is precipitated. The liquid is then distilled with peroxide of manganese in an iron still having a leaden cover and two arms; these are connected with two series of stoneware udells, in which the iodine is condensed in hard masses. After the iodine has been driven off, more peroxide of manganese is added, and the leaden arms are connected with another simple condensing apparatus, either of lead or earthenware, and the bromine collected therein. The makers are Messrs. W. and M. Paterson, Mr. Hughes, from kelp, and the North British Chemical Company from seaweed. I mention these particularly, for nearly all the chemical manuals refer to a maker, and his method, both of which have been things of the past for

Kelp Imports into Clyde, Years ending June 30.

	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
Tons of kelp	8358	8174	8116	8978	9257	9384	10,049	9449	10,923	8643
Price of iodine per lb...	10/	12/	12/8	13/	12/8	14/4	34/	24/8	15/8	10/8
	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865
Tons of kelp	6349	8641	8123	8190	7754	9722	9414	14,018	11,349	13,741
Price of iodine per lb...	13/8	12/4	10/6	9/8	8/6	7/	5/8	5/	8/4	7/8
	1846.	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.
Tons of kelp	3627	4000	4400	4731	11,421	7320	5418	6491	4679	5826
Price of iodine per lb...	2[illegible]3	11/	11/	11/	10/8	8/8	15/	15/4	12/	13/4
						1841.	1842.	1843.	1844.	1845.
Tons of kelp						2565	1887	1965	3263	6086
Price of iodine per lb...						5/	4/8	6/	12/	31/1

Fluctuations.

Average.	Ten Years, 1866 to 1875.
9187	8116 in 1868 to 10,923 in 1874.
15/11½	10/ in 1866 to 34/ in 1872.
Average.	**Ten Years, 1856 to 1865.**
9730	6349 in 1856 to 14,018 in 1863.
8/10	5/ in 1863 to 13/8 in 1856.
Average.	**Ten Years, 1846 to 1855.**
5811	3627 in 1846 to 11,421 in 1850.
12/11	8/8 in 1851 to 21/3 in 1846.
Average	**Five Years, 1841 to 1845.**
3133	1887 in 1842 to 6086 in 1845.
11/9	4/8 in 1842 to 31/1 in 1845.

over thirty years. Even Watts's "Dictionary," usually so accurate, repeats this error. Messrs. Paterson, of this city, who have for some years been the largest makers of iodine, have an excellent method of boiling down by steam, which is used also in some other chemical works here. The liquors are boiled down in large cylindrical wrought-iron vats, heated by a coil of steam piping, and aided by a mechanical stirrer. This method of boiling is said to effect a saving of fuel and labour, and is more cleanly in use than open pans.

The products obtained are iodine, bromine, "muriate," containing 80 to 95 per cent potassium chloride; "soft sulphate," containing 50 to 65 per cent potassium sulphate; "kelp salt," containing sodium chloride, and 5 to 10 per cent alkali; "kelp waste," containing mostly calcium carbonate and silica, used in the ordinary glass bottle works; and "sulphur waste," containing dry about 70 per cent sulphur. All these products retain iodine, and some require most careful washing to extract it.

The whole process has undergone little change for several years, because it furnishes at once good dry iodine fit for the market. In France, where a process of precipitation by chlorine is adopted, the iodine is obtained as a moist powder, and must be re-sublimed for the market, or made into potassium iodide.

Although the lixiviation of kelp is a small manufacture, the making of the raw material has been for more than a hundred years the chief support of thousands of poor crofters and cotters in Ireland and the West Highlands. The history of this manufacture is very interesting. It has never been written, and I fear never will be. A complete record of the imports of kelp into Clyde from the earliest period and the values would have been most instructive, as even the history of the alkali trade is not complete without it. Unfortunately, however, the Clyde tonnage books previous to 1859 have been disposed of to the paper mills, and the table of imports for the last thirty-five years in this paper was compiled with difficulty from indirect sources. I cannot help expressing my surprise that the Clyde Trust authorities, who have lavished expenditure on their noble river, should deem it worth while to sell such valuable records as waste paper. At one time a considerable quantity of kelp was also sent to Liverpool.

Kelp was first introduced about the middle of last century, and was employed in commerce for the sodium carbonate it contained. At the beginning of the present century it was worth from £20 to £22 per ton, and the western islands of Scotland alone produced 20,000 tons. The importation of Barilla then began, and during the twenty-two years ending 1822 the average price was only £10 10s. The duty was then taken off Barilla, and kelp fell to £8 10s., and in 1823, on the removal of the salt duty, it fell to £3, and in 1831 to £2. From then till 1845 it was still used in the soap and glass factories of Glasgow. In 1845 the manufacture of iodine commenced in earnest, and kelp was again in demand. But the kelp required was not the same, that which contained the most soda containing the least iodine. Moreover, it became valuable as a source of potassium chloride, the richer kelps in iodine containing the most, and this salt at one time was worth £25 per ton. The discovery of the Stassfurt mineral speedily reduced this price to about a third, and the further discovery of bromine in this mineral also reduced the price of that element from £1 18s. per lb. to 2s., about its present price. The amount of bromine produced from kelp is small, about a tenth of the iodine, and the total produce of France and Scotland is far exceeded by that of Germany alone: it is also imported in considerable quantity from America.

Manufacturers are now threatened with a still more formidable rival in iodine from the mother-liquors of the caliche of Peru. The total production of iodine here is 1000 to 1200 cwts., from about 10,000 tons of kelp. The production in France is rather less—about 800 tons, derived from double the amount, or 16,000 tons, of a kelp inferior in yield. The iodine in the caliche is estimated at 0·16 per cent, or 3·58 lbs. to the ton; and as about 600,000 tons are annually worked, if the whole of the iodine could be extracted it would amount to 18,750 cwts., or more than nine times the present total production. Even allowing that this is an over-estimate, and reducing it by a third, and then allowing half as the possible produce, it still leaves 6000 kegs as an output, or three times the present production. The makers there have, however, considerable difficulties to contend with; the iodine exists as an iodate, and the extraction cannot be effected completely. If, however, it could be extracted to any great extent, the smallness of the market would soon reduce the price below any possibility of profit, unless some new outlet can be found. We have no certain information as to the processes of extraction employed in the works at Peru, as they are kept very secret, and have been often changed; the iodine was at first exported as iodide of copper, and then as a crude iodine, containing about 50 per cent of iodine. It is now made of good quality, and it is probable that the iodine is reduced and precipitated by sodium bisulphite, and then re-sublimed.

We depend here entirely on the sea for our supply of iodine; according to Sonstadt it exists in sea-water in the form of calcium iodate: he estimates that it is present in the proportion of 1 in 250,000, and that a cubic mile of sea-water contains 11,072 tons. It is, however, much more difficult of detection than bromine, which, according to the same authority, exists as—

Bromine	1 in	3,333 parts.
Iodine	1 in	368,110 „

This is a high estimate compared to that of other authorities, who estimate the proportion of iodine at only 1 in 30,000,000. Certain species of Algæ have a remarkable power of eliminating and concentrating in their tissues these two elements, but as a rule they take up ten times as much iodine as bromine. I showed, some years ago, by a large number of analyses, that, though all the Algæ contain iodine, only a few species contain it in quantity. The following table gives the percentage amount of iodine in several Algæ. In my own figures I have taken the average of a number of analyses of the same plant, collected at different seasons all round the shores of Great Britain and elsewhere, widely distribnted, especially in the first five plants from which all the kelp is made.

The following table shows the proportion of iodine contained in 100 parts of the dried Algæ, according to various authorities:—

	Sarphat	Schweitzer.	Godechens.	Zenger.	Wallace.	Stanford.
Laminaria digitata	0·135	—	0·625	—	0·4440	A. Stem 0·4535
						B. Frond 0·2946
„ saccharina	0·230	3·880	—	—	0·2880	C. 0·2794
Fucus serratus	0·124	0·058	0·177	—	0·0565	D. 0·0856
„ nodosus	—	—	0·074	—	0·0396	E. 0·0572
„ vesiculosus	0·001	—	—	—	—	F. 0·0297
Zostera marina	0·0005	—	—	—	—	0·0457
Rhodomela pinnastroides	—	—	—	—	—	0·0378
Hyderix siliquosa	—	—	—	—	—	
Hymanthalia lorea	—	—	—	—	—	
Chordaria flagelliformis	—	—	—	—	—	
Cladophlora glomerata (fresh-water)	—	—	—	0·0227		

A. Average of 18 specimens.
B. „ 23 „
C. „ 5 „
D. „ 12 „
E. „ 4 „
F. „ 8 „

To show the general character of some of these specimens. I may add that they were taken from Larne, Ballina, Sligo, Galway, and Skibereen, in Ireland; Shetland, Tyree, Coll, Colonsay, Tobermory, Vallay, Baleshare, Boreray, Neisker, Stornoway, Skye, Tyree, Kilcreggan, Iona, Dunbar, Fife, in Scotland; Scarborough, Weymouth, and Worthing, in England; Peele, in the Isle of Man; also from Norway, Denmark, and Iceland.

The first five varieties in the table are those employed in making kelp, and are named in the order in which they contain iodine. The best is the *Laminaria digitata*, or deep sea tangle growing on rocks and always submerged; the next is the *Laminaria saccharina*, or sugar wrack (so-called because it is often covered when dry with a sweet efflorescence of mannite); this variety grows on sand or on loose stones, also submerged, but in shallow water. These two varieties are called drift weeds, because they are thrown up by storms. All the *Fuci* grow on the rocks and are all exposed at low water. These are cut from the rocks and are known as cut weeds. The *Fucus serratus*, or black wrack, is the longest submerged, and is the nearest to low water. This weed is said to contain silver; I have not, however, been able to detect this metal, though working on a considerable amount of the ash. The next is the *Fucus nodosus* or knobbed wrack, less submerged, and poorer in iodine. The least submerged and the poorest in iodine is the *Fucus vesiculosus*, or bladder wrack. Kelp made from the drift weeds will contain about four times as much iodine as that from the cut weeds; indeed, at present prices the latter kelp is almost worthless, some of it containing less than 3 lbs. of iodine to the ton, and worth about £1 per ton. As this involves the cutting, carrying, drying, and burning of 20 tons of wet seaweed in a very wet climate, no wonder the employment is dying out, and little of this kelp is now made.

The manufacture of kelp as generally carried out is wasteful in the extreme. The seaweed is spread out to dry on the shore in a climate subject to heavy rains whereby the kelpers' labour is often entirely lost. It is burnt in long kilns made of loose stone walls and turf; the burning seaweed here attains a very high temperature. This part of the work is done by women and children; the men of the family are then employed with iron clats to rake the ash up until it forms a molten slag. During this laborious process more than 50 per cent of the iodine is often dissipated, and a large amount of potash; indeed, so intense is the heat that sufficient soda is volatilised to give an intense monochromatic flame, and to render the sight of those working at the kiln at night like the last scene of a terrible melodrama. The high temperature also enables the carbon to deoxidise the alkaline sulphates to sulphides and other sulphur compounds; these become concentrated in the mother-liquor, and entail a large expenditure of oil of vitriol, and give rise to great nuisance in the lixiviation. It will be readily seen also that large amounts of sand and earth, stones and gravel can be thus raked into the kelp, and it is often enormously adulterated; so general is this adulteration that the kelp ton is in many places increased to 22½ cwts. to allow for it. The presence of silica sand greatly assists the volatilisation of the iodine.

Very little of the winter supply is collected on account of the difficulty of drying it, and this is the richest in iodine. These evils have been long known and often pointed out, especially by the late Mr. D. McCrummen and Dr. Wallace—the latter having suggested the rational remedy of burning to a loose ash; but such is the extreme difficulty of convincing the people that it is possible to change their ways, that after repeated efforts I have signally failed etting any improvement in this direction. The kelp made in the old time was from cut weed and the kelpers learned to burn it into a dense vitreous slag, and they persist in doing the same as their fathers before them, although the purpose for which it is now required demands exactly opposite precautions. In one island I took away all their kelp irons to prevent this poling; but arriving late one night near the scene of a kelp burning I saw the familiar yellow light arising from a kiln where several men were engaged in making themselves hideous in driving off, by hard night work half the weight and value of their produce. Yet they will not burn it into ash because they do not believe it would be heavy enough; the fact being that although the produce is lighter the actual yield is largely increased.

In 1862 I published a series of researches on the destructive distillation of seaweeds, which still further showed the enormous waste in kelp burning, and for which the Society of Arts awarded their silver medal. The researches were conclusive as to the loss of iodine by the ordinary method, and from experience since on the large scale I know it to have been considerably understated. The researches showed the necessity of carbonising the seaweed in a close vessel. By this process an extremely porous charcoal was obtained which, on lixiviation, furnished the whole of the iodine and salts present in the original weed; the yield of this charcoal was double that of kelp, and the produce of iodine more than double that from the kelp. Ammonia, acetic acid, naphtha, and tar were also obtained as products of distillation, and a considerable quantity of lighting gas.

The residual charcoal after lixiviation is new to commerce. It is a remarkably porous body with an extraordinary power of absorption and deodorisation. Its compositionis about midway between that from wood and that from bone in the proportion of carbon, but in general composition it much resembles the latter, from which it differs in containing more carbon, and carbonates of calcium and magnesium, and less phosphates. This substance can be obtained at a fourth the price of any other charcoal, and it exceeds them all in deodorising power; it is well worth the attention of chemists, as it could be obtained in large quantity, and has hitherto met with but a limited application. The usual composition of the two varieties is shown in the following table; the analyses are given for dry charcoal, but it is remarkably retentive of moisture.

Analyses of Residual Charcoal.

	Average Charcoal from	
	Laminaria.	Fucus.
*Carbon	52·54	70·32
Phosphates	10·92	1·90
Calcium carbonate	15·56	10·25
Magnesium carbonate	11·34	7 92
Calcium sulphate	—	1·93
Alkaline salts	5·70	1·84
Silica	3·94	5·84
	100·00	100·00
*Containing nitrogen=ammonia	1·75	2·30

The advantages of this method are that by retaining the whole of the iodine, and by utilising the winter supply, it largely increases the yield of iodine from a given extent of shore, and the manufacture being continuous gives much more employment to an indigent population, and it gives rise to a residual product of considerable value.

The process has only been carried out on the large scale on the Islands of Tyree and North Uist, in both which islands the people have enormously benefitted. I need only refer to the evidence of His Grace the Duke of Argyll before the Privy Council last year to prove this statement. That it will be greatly extended I have no doubt, when other proprietors of extensive shores, who have not hitherto shown the sagacity and foresight of His

Grace, will see the advantage of improving the local industry of their people instead of sending them away to improve other lands.

In concluding this short paper I would add that although my process is a great improvement in the manufacture of iodine it is not a general means of utilising seaweed, it is only applicable (unless a large demand arises for the residual charcoal) to the rich drift-weeds. The large fringe of cut weeds surrounding our shores, and easily accessible, is now almost unutilised except for manure. In a paper before the Chemical Society I have already pointed out the remarkable composition of the ash of seaweed as being more like that of an animal than that of a vegetable, lying as it does close to the border line of the two kingdoms. I hope before long to have something to say on the actual composition of the seaweed itself; the subject presents a large field for inquiry and is comparatively untrodden.

POSTSCRIPT.—Since this paper was read M. Thorwald Schmidt, the director of the Chemical Works at Aalborg, in Denmark, has proposed the working of kelp in connection with the manufacture of soda by the ammonia process. He claims to have reduced the loss of ammonia to under 2 per cent of the sulphate used. The samples of sodium carbonate forwarded to me by M. Schmidt are of great purity. His only difficulty is the utilisation of the residual liquor containing chlorides of sodium and calcium. This liquor is not worth boiling down there to recover the salt, and from the high import duty on salt it is too valuable to throw away. He proposes to utilise the alkaline sulphates in the kelp leys as precipitants for the calcium, retaining the alkalies in the liquor as chlorides. This process is quite feasible: calcium chloride was at one time used in some kelp works for the purpose of converting the sulphates of potassium into chloride, which was then much more valuable. After the iodine has been precipitated as iodide of lead the solution is boiled down and nitrate of sodium added, the potash being all crystallised out as saltpetre. The residual chloride of sodium solution is used again in the ammonia soda process. The principal seaweed on the Denmark shores is the *Zostera marina*, and the *Fuci*. I have examined several of these Danish seaweeds; all are poor in iodine, but the *Fuci* are particularly suitable for this purpose, being rich in alkaline sulphates.

Glasgow.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 19, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, confirmation of the minutes of the previous meeting, &c., the following certificates were read for the first time:—W. H. Ellis, W. Lapraik, J. L. Notters, I. Scarf, H. G. Stacy. The following papers were read:—

"*On the Estimation of Manganese in Spiegeleisen, and of Manganese and Iron in Manganiferous Iron Ores*," by E. RILEY. 1. *Estimation of Manganese in Spiegeleisen.* There are two methods now in use:—(*a*) *The Direct Method.*—The pulverised spiegeleisen (about 1 grm.) is dissolved in dilute nitric acid, sp. gr. 1·2, a little chlorate of potash and hydrochloric acid added to destroy the soluble organic matter from the combined carbon; the solution, diluted to about a litre, is neutralised with carbonate of soda or ammonia, acetate of soda or ammonia added, the solution boiled, the basic peracetate of iron allowed to settle and filtered off. This precipitate is re dissolved in hydrochloric acid, and the process repeated to ensure complete separation of the manganese. The filtrates are evaporated to 1½ litres, allowed to cool, 2 to 4 c.c. bromine added, the solution well shaken, 0·880 ammonia added in excess, the solution heated gradually for an hour, boiled for a few minutes, the precipitate allowed to settle, filtered (the filtrate should be evaporated and tested for manganese) dried, and ignited in a muffle or over a gas blowpipe for half an hour. (*b*) *The Indirect Method.*—The finely powdered spiegeleisen (about 1 grm.) is dissolved in dilute sulphuric or in hydrochloric acid, the liquid diluted with recently-boiled, cooled, distilled water, and the iron estimated volumetrically; to the percentage of iron thus obtained 5 per cent is added for carbon and impurities, the difference is assumed to be manganese. The results obtained by this method are usually too low, from the formation of soluble organic matter during the process of solution. This error can be obviated by using nitric acid for a solvent, evaporating to dryness and heating; the oxides of iron and manganese are then dissolved in hydrochloric acid, the solution largely diluted, and reduced with sodium sulphite. Results obtained thus agree very closely with the direct method. The author gives 14 analyses showing that the addition of 5 per cent for impurities to the percentage of iron is a fair one. Thus, for all practical purposes, the indirect method is sufficiently accurate, and can be accomplished in one hour, the direct requiring five or six hours. The author strongly recommends the use of acetate and carbonate of ammonia instead of the corresponding soda salts in the direct method, and proves, by check experiments with pure sulphate of manganese, &c., the statements of Fresenius and others, that the presence of ammoniacal salts prevents the complete precipitation of manganese by bromine and ammonia, to be erroneous. On the other hand, if soda salts be used the ignited precipitate will contain soda. The author considers that sulphur cannot exist in spiegeleisen. He determines the carbon by dissolving the iron in neutral chloride of copper, and after complete solution of the iron and precipitated copper the carbon is filtered on asbestos, and burnt with oxide of copper in a current of oxygen; the carbon determinations by the colour test are unsatisfactory for high percentages of carbon. According to the author the percentage of carbon varies with the percentage of manganese. The methods of Mr. Parry (CHEMICAL NEWS, vol. xxix., p. 86) and of Mr. Galbraith (vol. xxxiii., p. 49) were considered and stated to be undesirable methods. 2. *Estimation of Manganese in Manganiferous Iron Ores.*—These ores contain baryta, many contain oxide of zinc, and some potash or soda in appreciable quantities. The use of ammoniacal salts as mentioned in the previous part of the paper prevents any large error from the presence of the oxide of zinc, but it is difficult to get rid of the baryta; even in the presence of sulphuric acid it remains in combination with the manganese, and is precipitated with it unless special precautions be taken. Lime, if present, may also be precipitated with the manganese. After insisting on the importance of taking fair samples and of determining all the constituents directly, the author gave the following process as the one which yielded the best results:—1 grm. of the ore dried at 100° C. is dissolved in hydrochloric acid, the siliceous matter separated by filtration, and the larger portion of the free acid driven off. The liquid is made up to about ½ of a litre, and allowed to stand for four hours, after adding a few drops of sulphuric acid to separate any baryta. The solution is now diluted to about 1 litre, neutralised with ammonia after the addition of acetate of ammonia; boiled, allowed to settle, and filtered; the unwashed precipitate is re-dissolved in hydrochloric acid, and again precipitated with ammonia and acetate of ammonia. The basic peracetate of iron, after settling, is filtered off and washed three or four times with boiling distilled water, containing a few drops of acetate of ammonia. The filtrate is evaporated to 1½ litres, when cold, 2 to

4 c.c. of bromine added, and the process completed as described above. After ignition the precipitate should be dissolved in a small quantity of hydrochloric acid, the residue, if any, filtered off, a drop of sulphuric acid added, and the precipitate, if any occurs, separated. It is most important to test the ignited Mn_3O_4 for impurities, baryta, zinc, lime, &c. Chlorine can be substituted for bromine, but without advantage. The sulphide of ammonium process the author considers to be most objectionable. 3. *Estimation of Iron.*—The author recommends a standard solution of bichromate of potash, the results being usually a little high. As a reducing agent sulphite of soda prepared in the laboratory is used, the purchased samples being always impure; bisulphite of soda should not be used. The percentages of iron in 60 samples of steel rails are given, determined by weighing as Fe_2O_3 and by standard solution of bichromate of potash; the mean difference between the two methods is 0·073 per cent.

Dr. GLADSTONE said that the Society must feel greatly indebted to Mr. Riley for giving them the benefit of his experience in so elaborate a manner, especially as the determination of manganese had now become a matter of such great importance.

Mr. FIELD asked if Mr. Riley had tried hydrated oxide of lead in suspension for effecting the separation of barium, manganese, and iron; cobalt and nickel were entirely separated from iron by its use.

Mr. RILEY said that the acetate of ammonia process was so beautiful that he should prefer it, and, besides, there would be the additional trouble of getting rid of the lead. In answer to Mr. Heathfield, the barium, in the case of a sample of ore containing 14·87 per cent Ba, was combined with the manganese.

"*On a Method of Detecting Small Quantities of Bismuth*," by M. M. PATTISON MUIR, F.R.S.E. The author finds that the following test-liquid (see "Researches on Bismuth," by R. Schneider, *Pogg. Ann.*, lxxxviii., p. 45) is a very delicate qualitative test for bismuth:—12 grms. crystallised tartaric acid and 4 grms. stannous chloride are dissolved in caustic potash, so as to produce a clear liquid having a distinctly alkaline reaction: this liquid must remain clear at 60° to 70° C. To the liquid to be tested is added a considerable quantity of tartaric acid. It is warmed, and made alkaline with caustic potash. A few c.c. of the stannous chloride solution (which the author proposes to call Schneider's reagent) are now added, and the mixture warmed to 60° to 70° for a few minutes. If bismuth is present a brownish black colour is produced, from the formation of hypobismuthous oxide (Bi_2O_2). 1 part of bismuth in 210,000 parts of liquid may be thus detected. The absence of mercury must be secured before applying the test. Copper and manganese interfere slightly; lead, arsenic, antimony, iron, cobalt, nickel, and chromium not at all. The author hoped to have perfected a volumetric method from the above reaction, but has not succeeded.

Mr. FIELD mentioned that the precipitation of iodide of lead was an exceedingly delicate test for the presence of bismuth. If no bismuth was present the iodide of lead was precipitated of the usual yellow colour if one-thousandth part of bismuth was present; the precipitated iodide was of a distinctly darker colour.

"*On Certain Bismuth Compounds (Part V.)*," by M. M. PATTISON MUIR, F.R.S.E. By precipitating a nearly neutral solution of bismuth nitrate with potassium ferricyanide, washing by decantation, and drying *in vacuo* over sulphuric acid, pure bismuth ferricyanide is prepared as a tawny yellow amorphous powder with a shade of green. Its formula is $Bi_{35}FeCy_6$. It is unaltered in moist or dry air; suspended in boiling water, hydrocyanic acid is evolved; it is partially decomposed by drying at 100° C. By the action of chlorine, bromine, and nitric acid bismuth ferrocyanide is converted into bismuth ferricyanide. The ferricyanide is decomposed by the action of chlorine when suspended in water, or in the presence of cold or hot solutions of caustic soda. A method for analysing bismuth ferrocyanide and bismuth ferricyanide is given. Bismuth ferricyanide is converted by sodium amalgam into the ferrocyanide. When heated in closed crucibles both salts yield a black brown mass containing iron, bismuth, carbon, and small quantities of cyanogen.

"*Notes on Madder Colouring Matters: Munjistin, Purpurin, and Purpuroxanthic Acid* (Continuation)," by E. SCHUNCK, Ph.D., F.R.S., and H. ROEMER, Ph.D. *Munjistin.*—The authors found this substance to resemble purpuroxanthic acid, softening at 125°, fusing at 130°; when further heated it evolved carbonic anhydride, and was converted into purpuroxanthin. After criticising the conclusions of M. Rosenstiehl (*Comptes Rendus*, lxxxiii., 827), who states that his purpurin is identical with purpuroxanthic acid, and that the latter is formed from pseudopurin, the authors claim, having been the first to discover among this series of bodies one containing a carboxyl group, to be left for the present in undisturbed possession of the field they have opened up, *i.e.*, the preparation and examination of such members of the series as are formed from alizarin and its isomerides, as well as from the isomerides of purpurin by the substitution of *n*H by *n*COOH. *Purpurin.*—The specimen examined had a melting-point which remained constant after it had been converted into the acetyl compound and again liberated. Its formula was $C_{14}H_8O_5$: it was easily soluble in boiling spirits of wine, yielding a yellow solution, from which it crystallises on cooling in thin flattened prisms of a deep orange colour. The crystals lose water at 100° C., and contain 1 molecule of water. Purpurin melts at 253°, but begins to sublime at 150° in red plumose or acicular crystals. It is slightly soluble in boiling water, and dissolves in ether, readily in carbon disulphide, benzol, and glacial acetic acid. It dissolves in concentrated sulphuric acid, in caustic potash, soda lye, sodium carbonate solution, and ammonia. These solutions give absorption spectra. In alcoholic potash and soda purpurin is almost insoluble. It forms with baryta and lime-water purple lakes. A solution of purpurin in caustic alkali loses its colour on exposure to the air, the purpurin disappearing entirely: this is due to oxidation. Purpurin dissolves in boiling alum liquor, forming a pink fluorescent solution containing purpurin in a loose combination with alumina. This solution is precipitated by the addition of a little sodium carbonate or ammonia, though the liquid may still retain an acid reaction. An alcoholic solution of purpurin gives with lead acetate a crimson precipitate soluble in excess of alcoholic lead acetate; the precipitate obtained with alizarin is insoluble in excess. With copper acetate purpurin in alcohol gives a dark reddish yellow precipitate; a solution of alizarin becomes purple, but gives no precipitate. *Triacetyl-purpurin* softens at 193°, and melts at 198° to 200° C. It is decomposed by dilute caustic potash, yielding purpurin; analysis gave the formula—

$$C_{14}H_5(C_2H_3O)_3O_5.$$

Brom-purpurin is obtained by digesting purpurin with carbon disulphide containing bromine at 150° to 200° C. It crystallises from glacial acetic acid in dark red needles melting at 276°. Its properties resemble those of purpurin. Its formula is $C_{14}H_7BrO_5$. By heating pure purpurin for 6 to 7 hours in sealed tubes to 300° C., a small quantity of quinizarin is formed, and a quantity of by-products; no alizarin is formed. Quinizarin crystallises in bright red needles, melting at 193° to 194° C. Its ethereal solution is strongly fluorescent. It is soluble in alum liquor, giving a red solution with two absorption-bands.

The Society then adjourned to May 3, when the following papers will be read:—(1) "On some Points in Gas Analysis," by J. W. Thomas; (2) "On Nitroso-β-naphthol," by Dr. Stenhouse and Mr. Groves; (3) "On the Action of Pyrogallate of Potash on Nitric Oxide," by W. J. Russell and W. Lapraik; (4) "Asbestos Cardboard, and its Uses in the Laboratory," by W. N. Hartley.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, Quesneville.
March, 1877.

New Process for Determining the Co-efficient of Purity of Saccharine Solutions.—P. Casamajor.—Incapable of useful abstraction.

Poison of Putrid Matters, Bacteria, and Blood-Poisoning.—Dr. P. L. Panum, with Critical Observations by Ch. Blondeau.—A lengthy paper, which can scarcely be regarded as chemical.

Studies on Beer.—M. Pasteur, abstracted by Ch. Graham.—Translated from an English source.

Analytical and Industrial Examination of an Egyptian Petroleum.—F. Weil.—The specific gravity of this petroleum is 0·953, whilst the oils from Pennsylvania and Canada range from 0·790 to 0·830. It yields a superior lubricating oil, free from tarry matters, and a lighting oil of inferior quality. It is especially adapted for heating marine steam-boilers, as it does not take fire below 135° C.

Manufacture of Indian Sarrongs, of the "Batick" Style.—A. Schultz.—Detailed directions for imitating these cloths, as produced in Java.

True Sense of the Words "Iron" and "Steel."—L. Gruner.—Substantially a report which has appeared in the *New York Mining Journal* (Oct. 28th, 1876, p. 278).

New Battery with Peroxide of Manganese.—G. Leclanche.—Taken from the *Comptes Rendus*.

April, 1877.

Purification of the Seine.—Hip. Stupuy.—A long and unimportant treatise.

Report on Saccharimetric Methods, and the Yield of Crude Sugars on Refining.—MM. Bardy, de Luynes, Girard, and Riche.—Incapable of useful abstraction.

New Igniter for Automatic Torpedoes.—MM. Champion and Pellet.—Unintelligible without the accompanying figure.

Review of Foreign Researches.—E. Noelting.—The papers here given are taken from the *Berichte der Deutschen Chem. Gesellschaft*, and consequently have been, or will be, noticed under that head.

On Nitrification by Means of Organic Ferments.—Th. Schloesing and A. Muntz.—Already noticed.

Reimann's Färber Zeitung, No. 13, 1877.

The principal article in this issue is an account of chrysoidin, by Dr. A. W. Hofmann, taken from the *Berichte de Deutschen Chem. Gesellschaft*.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 13, March 29, 1877.

The Abbé Moigno continues his denunciation of M. Flammarion.

The "Society against the Abuse of Tobacco" offers a prize of 200 francs to the medical man who shall bring forward the greatest number of interesting and unpublished observations on diseases caused by tobacco.

No. 14.

Absorption Radiometer.—M. Thore, of Dax.—This apparatus is described and figured. Its construction cannot be made intelligible without the accompanying illustrations.

A correspondent of *Les Mondes*, M. Nic, of Vienna, writes that a person in his district is in possession of a "certain cure" for rabies.

MEETINGS FOR THE WEEK.

MONDAY, April 30th.—Medical, 8.
— Society of Arts, 8. (Cantor Lectures). "The Connection of Greek and Roman Art with the Teaching of the Classics," Sidney Colvin, M.A.
— Zoological, 1. (Anniversary).
— Philosophical Club, 6. (Anniversary).
TUESDAY, May 1st.—Civil Engineers, 8.
— Royal Institution, 2. (Annual Meeting).
— Zoological, 8.30.
WEDNESDAY, 2nd.—Society of Arts, 8. "Continuous Brakes for Railways" Capt. Tyler, R.E.
— Microscopical, 8.
THURSDAY, 3rd.—Royal, 8.30.
— Royal Institution, 3. "Heat," Prof. Tyndall.
— Royal Society Club, 6.30.
— Chemical, 8. "On some Points in Gas Analysis," J. W. Thomas. "On Nitroso-β-Naphthol," Dr. Stenhouse and Mr. Groves. "Action of Pyrogallate of Potash on Nitcic Oxide," W. J. Russell and W. Lapraik. "Asbestos Cardboard and its Uses in the Laboratory," W. N. Hartley.
FRIDAY, 4th.—Royal Institution, 9. "Researches on the Origin and Development of Minute and Low Forms of Life," Rev. W. H. Dallinger.
— Society of Arts, 8. (Indian Section). "Thaumatodendra, or the Wonders of Trees," with Illustrations from Life. Mr. William Tayler.
SATURDAY, 5th.—Royal Institution, 3. "Babylonian Literature," Rev. A. H. Sayce.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 916.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 235.)

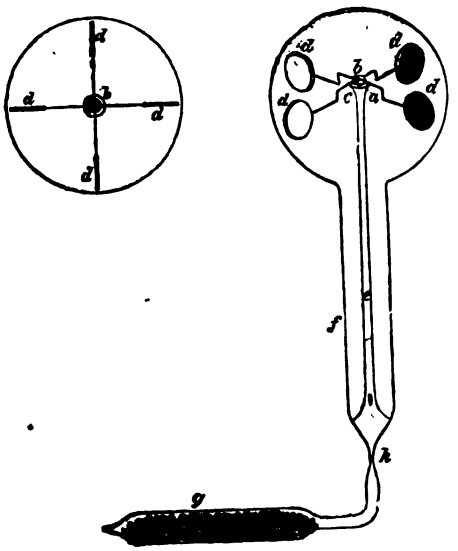
144. WHEN the vacuum is within a few millimetres of being perfect, the arms of this instrument move when a candle is brought near; as the pump continues working rotation commences, which gets more and more rapid, until, with the candle close to the glass, several revolutions are made per second. When well exhausted, the following experiments were tried;—

A flask of boiling water, placed 1 inch from the outer glass, caused the arms to set at right angles to the line joining the flask and the pivot, showing that the heat from boiling water acts on black and white surfaces equally (128).

Copper at 400° C. kept the arms revolving, at first quickly, then slowly, until, as the copper cooled, the rotation stopped, and the black and white surfaces ultimately set equidistant from the hot metal (128).

A candle always set the arms revolving, when it was near enough for the force to overcome the friction.

FIG. 6.



This showed that rotation was possible, and that it would be kept up as long as the radiation lasted; and I accordingly devised a form of apparatus which would enable this action to be shown with greater facility. Owing to there being only two disks, the action of light was not uniform, as if it struck the arms at the end, instead of at the side, movement would not be commenced. Also the cement joint rendered it impossible to get the vacuum very good, whilst it took away from the permanent character of the instrument. After many trials of different arrangements, an instrument was made which had none of these defects, whilst it showed the movement of rotation in a very convenient manner.

145. The apparatus is shown in fig. 6. It consists of four arms, of very fine glass, passing horizontally through pieces of pith (*b*), and afterwards bent twice at right angles, as shown in the figure. Through the centre of the pieces of pith (*b*) is passed vertically the point of a very fine sewing-needle (*a*), which rests in a glass cup (*c*) blown on to the end of the glass tube *e*. At the end of each glass arm is fastened a thin disk of pith, white on one side and lampblacked on the other, the black surfaces of all the disks facing the same way. The whole is enclosed in a glass bulb blown on to the end of a wide tube. *f* is a piece of cement to keep the support (*e*) in its place. *g* is the tube containing cocoanut-shell charcoal; the other end is sealed on to the mercury-pump. The exhaustion is effected as already described (131); and the apparatus is then sealed off, with the charcoal-tube still attached to it. Ultimately, when all the residual gas has been absorbed by the charcoal, a flame is applied to the contracted part of the tube at *h*, and the charcoal-tube is disconnected.

146. Before adopting the above method of making these instruments many experiments were tried, both to secure ease of manipulation and greater delicacy of action. The cup supporting the needle-point was made of ruby, sapphire, chrysolite, aquamarine, and agate; it was, however, found that these offered no advantage over glass, as the friction was not sufficient to produce any abrasion of the glass by the steel point. The disks at the end of the arms were made of every imaginable substance which was likely to answer. Among these I may mention wood, paper, flies' and butterflies' wings, talc, mica, selenite, thin glass, metals of various kinds, ivory, cork, and pith (86). For general purposes I prefer pith, as it is easily cut into slices, is extremely light, dries readily in a vacuum, and does not evolve vapour subsequently; besides which its natural white surface is almost as insensitive to radiation as any substance I have yet examined.

The number of disks has been varied from ten, the maximum which can follow one another without available surface being uselessly obscured, to two, or even one, which latter form has been experimented with, and possesses some advantages. Six disks are a useful number; but as the difficulty of making these instruments increases with the number of arms and disks to be got into the bulb, I prefer four disks for ordinary purposes.

The material of which the arms are made has also been the subject of experiment. My earlier instruments (exhibited at the Soirée of the Royal Society on the 7th of April, 1875) had straw arms. These are, however, too heavy, and are liable to evolve vapour after being kept in the vacuum for some time. An inorganic body is preferable; and I have finally adopted either thin rolled brass or fine glass thread drawn from thermometer tubing.

The colour of the disks has also been experimented on. During this part of the inquiry many curious results have been obtained, which will be described further on. At present, however, I have found nothing better than lampblack for the black surface and the freshly-cut pith for the white surface. In working with cork, metals, &c., where the natural surface is not white enough, oxide of zinc may be used as a coating for the white surface.

147. The lampblack is best applied to the pith surface in the following way:—Camphor is burnt, and a sheet of glass is held close over the flame. An abundant deposit of lampblack takes place. A brush dipped in alcohol is then rubbed over the deposit, and the surface is painted over with the mixture. The lampblack adheres very well to pith, and in a few hours the alcohol and moisture have dried off, and a dead black, very even surface is the result. In some cases I smoke this again over burning camphor; but this is not of much use, unless the first coating shows glistening patches or is not laid on evenly.

(To be continued.)

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

ON THE

OXIDATION OF GOLD, AND SUPPOSED OXIDATION OF MERCURY BY OXYGEN IN PRESENCE OF WATER.*

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

THIS paper states the results of the investigation I promised at our last meeting relative to the oxidation or otherwise of gold, under circumstances which have not been hitherto supposed favourable for such oxidation. They show, and I think pretty clearly, that this metal *is* oxidised superficially under them, as seems demonstrated by the following facts, which I give as expressing the general results of the very numerous and often-repeated experiments which I have made:—

1. That gold immersed for a few hours in spring water, or in water charged with any neutral salt, refuses for a long time to amalgamate when next immersed in mercury.
2. That it is also passed to this condition by contact for about eighteen hours with distilled water, from which ammonia and other nitrogen compounds have been removed.
3. That it is also thus affected by being placed in contact for a very short time with an aqueous solution of caustic or carbonated alkali or ammonia, at their boiling-points respectively, or for a somewhat longer time when the solution used is at a common temperature.
4. That gold is also passed to this condition when ignited with a weak solution of sodic carbonate.
5. That when put into this condition as to its surface, it becomes readily amalgamable by a short contact with either weak acetic or hydrochloric acid; also, by ignition, except in the case where ignition has been resorted to, to produce this particular condition of such surfaces.

These facts prove, I think, that gold is chemically acted upon when in contact with water or neutral saline solutions charged with oxygen and nitrogen gases, and that this action is facilitated by the presence of alkaline substances, and especially when these are used hot in place of being used cold. It seems to me there can be little doubt entertained but that gold thus acted upon has been oxidised, and this either to a sub oxide or to the purple oxide of gold.

The gold used in these experiments was prepared as pure as possible. Some I twice precipitated by oxalic acid, from very dilute solutions of its chloride.

Other gold I electro-deposited on platinum from its cyanide. Both samples gave similar results, but that obtained by deposition yielded them quicker, owing, perhaps, to the fact of its being coupled with platinum.

There are two circumstances connected with this subject I should relate which puzzled me a great deal, as they hardly seem to tally with certain reactions of this metal as now known. They are—first, that proto-sulphate of iron in contact with gold which has been acted upon by alkaline solutions or water does not render it amalgamable; secondly, that sunlight, even direct, does not appear to exercise any influence in the reaction I have described. Possibly, though, the purple oxide of gold may prove on examination to be invulnerable in these respects.

I may further relate that gold in either argentic nitrate or mercuric chloride rapidly becomes non-amalgamable, but as it is recovered to its former condition by acetic acid, I question whether either of these salts are decomposed here. I further find that pure gold, fused with borax and bisulphate of potash, though very bright, will not amalgamate; the solution of flux was acid. In weak sulphuric acid also gold passes to this non-amalgamable condition.

These results, however, and the question they raise demand investigation, and I hope soon to be able to accomplish this to an extent which will enable me to throw a clear light upon the subject under consideration. Whatever may be the precise nature, however, of the film thus induced upon gold, and of the reactions which result in the removal or alteration of this film as here described, it is certain that films of this kind must cover the surfaces of a portion of our native gold, and thus retard to a more or less extent, its complete amalgamation when milled.

Thus what with the tendency of this metal to enfilm in presence of common water or alkaline solutions in the manner described, and its tendency to become sulphuretted when in contact with soluble sulphides, there can be but little doubt entertained that most of the natural surfaces of native gold are varnished, as it were, with auriferous compounds, and these have to be decomposed by mercury ere amalgamation can proceed, except we use in conjunction with this metal a substance capable of decomposing such films, or else remove them mechanically, as is at present largely accomplished in the stamper boxes.

With reference to mercury, the results I have as yet been able to get do not point so distinctly to its oxidation by oxygen in presence of water, as those described above do to that of gold. Its mobility at the temperature I have to operate under stands in the way of my observing indications of any superficial change I may have induced upon it in my experiments. Theoretically it would on first thought appear, that if gold or silver does oxidise, as I affirm, under the above circumstances, mercury should also oxidise under them, as it is certainly positive to both these metals in acid generally. It must be considered, however, in connection with this matter, that gold and silver at their fusing-points are in a condition unfavourable to their oxidation, and so mercury (a metal which naturally classes with these), being used in my experiments at a temperature far above its fusing-point, may for this reason be less readily oxidisable under the circumstances stated than either of the above metals in their solid state. It appears to me that we should take into consideration here not only the temperature we are operating under but the different physical conditions of mercury as compared with that of the above metals at this temperature.

The only results I have yet obtained as to the oxidation of mercury or otherwise under these circumstances seems to show that it is so oxidised. Thus I find that electric currents of some strength are generated by it in water containing a little sodic chloride; also in aqueous solution of caustic or carbonated alkali; as the only conceivable effect of the salts named is to conduct the electricity thus generated and so render it detectable, I conclude that the action upon mercury which these currents indicate is not originated by such salts, but by the oxidation of this metal.

Supposing, however, oxidation does occur under the circumstances related above, this may have been induced in part by the oxygen condensed upon the platinum, or carbon which I used in conjunction with the mercury in these experiments, as the negative pole.

If this should on further investigation prove to be so, the question as to the oxidation or otherwise of mercury in presence of oxygen and water alone, practically remains unsettled. So far indeed as these experiments and our general knowledge of the behaviour of this metal show, it appears, that in alkaline solution or in water generally, mercury is probably less readily affected than either gold, silver, or platinum.

The result, however, stated in this paper shows, I think, very clearly that the metals, silver, platinum, and gold, readily oxidise under ordinary circumstances, though only to a small extent. Thus the film of oxide, or rust, as I may properly term it, which is thus formed, never acquires any notable thickness, and so does not manifest its pres-

* Read before the Wellington Philosophical Society, February 12th, 1876.

ence readily to mere physical tests. But this limitation in thickness of such films is not due to want of or weakness of affinity between the underlying metal and oxygen, but rather to the great solidity of these films, and their adherence to the metal, together with their insolubility in the liquid surrounding them, whereby these affinities very soon have their action permanently restrained; contact of the metal with oxygen being thus cut off. Practically there is neither scaling off nor yet any dissolving away of the oxide, or its saline representative, as we have with iron or copper; thus the underlying metal is soon completely protected.

Possibly the knowledge that these metals are chemically acted upon by oxygen may help us to explain the origin of those electric currents which Professor Becquerel obtained by immersing certain "non-oxidisable metals" in pure water. Why should not these currents be in many cases due to the kind of oxidation I have just described, that is to chemical action, rather than, as Professor Becquerel attributes, to "capillary affinity?" Not only this, indeed, but so far as the results I have here given can be taken as correct, it seems certain that a number of cases of so-termed *mechanical* absorption are resolved thereby into cases of *chemical* absorption—chemical affinities being the operant power. This aspect of my subject, however, and certain other matters of interest in connection therewith, I forbear to treat for the present, as I hope to be able soon to take up this subject again.

ON THE ESTIMATION OF MANGANESE IN SPIEGELEISEN AND FERRO-MANGANESE.

By SERGIUS KERN, St. Petersburg.

SPIEGELEISEN and ferro-manganese are at present much used in the manufacture of steels. A great many analyses of such kind are made in laboratories of iron- and steel-works; very often slags from Siemens-Martin furnaces are also tested for manganese, in order to accurately ascertain at any stage of the operation the proper state of the metallic-bath of the furnace.

The following method, communicated by me to the Russian Chemical Society on the 7th of April, 1877, may be for technical applications strongly recommended:—0·05 grm. of the spiegeleisen or ferro-manganese, in powder, is dissolved in 20 to 25 c.c. of aqua regia; the solution is evaporated to dryness, and the resulting mass is re-dissolved in a mixture of 10 c.c. of hydrochloric acid and 15 c.c. of water. The residue, consisting of silica, is filtered off. Iron and manganese are next precipitated, in the form of hydrates, by ammonia: this mixture is concentrated and poured into a platinum crucible, and evaporated to dryness. The dry mass is placed in a weighed tube of hard glass, heat is applied, and at the same time a current of dry hydrogen is passed through the tube; the following reaction takes place:—

$$Fe_2(OH)_6+Mn_2(OH)_6+8H=Fe_2+2MnO+10H_2O.$$

When the mass turns greenish, instead of hydrogen a current of dry chlorine is passed, which transforms the metallic iron into a volatile compound, ferric chloride (Fe_2Cl_6): the chlorine is passed for about 30 to 40 minutes; when the iron is volatilised, a free current of air is passed for about one hour: during this last operation the tube must also be heated by a Bunsen burner. The substance in the tube burns brownish, and mangano-manganic oxide is formed (Mn_3O_4). The tube in a dry state is secondly weighed, and the difference in the weights of the empty tube and the same tube containing Mn_3O_4 will show the quantity of mangano-manganic oxide in the specimen analysed. As this oxide contains 72·05 per cent of manganese, the percentage of manganese in the sample is easily calculated.

Ten analyses were executed by this process on samples in which the manganese was firstly estimated by the well-known Eggertz bromine process. The experiments proved that the difference in the estimation of manganese in the ordinary way and by the above-mentioned process varied between 0·04 and 0·01 per cent. These results show that the process may be safely used in technical and metallurgical applications.

At first sight the new process seems to be very complicated in execution, but practice proved that the work is executed by this method far more quickly and easily than by any other analytical methods.

Some experiments were made in order to simplify the above-described process: they are not yet finished, but altogether it may be found useful to give a short notice of them.

If finely-powdered ferro-manganese is ignited with ammonium-chloride in a high crucible with a metallic cover, the ferric chloride obtained by the reaction,—

$$6NH_4Cl+Fe_2=Fe_2Cl_6+6NH_3+3H_2,$$

is volatilised, and condenses in the form of small crystals on the cold metallic surface of the crucible-cover. The cover is gently put off, and the contents of the crucible are dissolved in aqua regia; silica is filtered away; the filtrate is evaporated to dryness in a platinum crucible, which is next strongly heated in the presence of air; the resulting mangano-manganic oxide is weighed, and the percentage is calculated as ordinarily. This process is far more easily executed than the process just mentioned. The analyses which are now in execution will show the accurateness of this analytical method.

Obouchoff Steel Works.

ON THE PROPERTIES OF RESORCIN.

By M. L. CALDERON.

HAVING at disposal a very large quantity of resorcin, I proposed to determine its physical and chemical properties, commencing with the former.

Commercial resorcin, prepared by means of phenol sulphate, appears ordinarily as a brown humid mass, which possesses a strong odour of phenol, and is often found contaminated with tarry matters, and sometimes also with sulpho-vinic acid and oil of wine. The best process of purification consists in treating the matter with water and a small quantity of lye of soda. A quantity of hydrochloric acid is added insufficient for complete neutralisation; it is agitated with ether, which deposits it in the form of large crystals, weighing sometimes several grms.

Although the form of these crystals has been already studied by M. Groth, I have thought it useful to make it the subject of a new examination. They belong to the orthorhombic system, and present the combinations:—∞P (110), $P\breve{\infty}$ (101); often also ∞P (110), $\infty P\bar{2}$ (120), $P\breve{\infty}$ (101). I have not fonnd in my sample the hemimorphism pointed out by M. Groth; this may depend on the nature of the solvent and the temperature at which the crystals are formed. The following are my measurements:—

	Calderon. Degrees.	Groth. Degrees.	Calculated. Degrees.
(101) : (101)	119·70	118·37	—
(101) : (101)	60·19	—	60·53
(110) : (110)	95·15	95·22	—
(110) : (110)	84·10	—	84·45
(120) : (120)	121·57	121·54	122·33
(101) : (120)	75·11	—	75·46
(110) : (120)	161·29	—	161·30
(110) : (101)	68·45	—	70·90

$$a : b : c = 0{\cdot}912326 : 1 : 0{\cdot}587577.$$

The crystals often appear elongated along the axis a, and sometimes having all the appearance of perfect octahedra.

Resorcin melts at 118°, a melting-point higher by 19°

than that which is commonly admitted. At 90° it gives appreciable vapours and boils at 276·5° under the pressure of 759·7, and between 200° and 210° under a pressure of 7 millimetres. If we melt the substance in a retort and if we heat it up to 220° to 230°, passing through the liquid a current of carbonic acid, or if we heat it to between 140° or 150° to sublime the matter, we may condense in the receiver small crystals as white as snow, extremely fine, and which present under the polarising microscope the phenomenon of lamellar polarisation, but in which I have been unable to recognise the direction of extinction, and whose crystalline system I have been unable to determine. Resorcin heated to 300° is decomposed, leaving a carbonaceous residue.

The vapour density cannot be determined by the common process. Nevertheless, by employing a method applied ten years ago by Berthelot for the determination of the density of the vapour of copahuvin, I have succeeded in obtaining the following results:—

		T.	H.
First experiment	3·918	240°	0·018 m.
Second „	3·806	250°	0·080 m.
Mean	3·862		
Calculated	3·8078		

The density of the solid matter was determined with the specific gravity bottle under a layer of sulphide of carbon, in which resorcin is quite insoluble; I have found—

	0°.	15°.
Solid crystalline matter ..	1·2728	1·2717

The coefficient of dilatation of the solid matter is 0·00007868 between zero and 15°; its molecular volume is consequently—

At zero	86·43
At 15°	86·51

In order to compare its molecular volume with that of phenol and that of benzol, I have determined by means of the specific gravity bottle, the densities of the liquid compound at the temperatures comprised between its point of fusion and 178°. I have obtained the following results:—

Temperatures.	Spec. Gravs.	Molecular Vols.
118°	1·1923	92·260
130	1·1862	92·730
136	1·1812	93·125
145	1.1738	93·710
150	1·1691	94·090
165	1·1556	95·189
170	1·1503	95·627
178	1·1435	96·196

The densities obtained in this manner decrease regularly and coincide sensibly with the curve of the densities calculated by means of the coefficient of dilatation obtained by means of the two extreme densities, and also by the direct observation of the augmentation of volume. This coefficient of dilatation is equal to 0·0007114 between 118° and 178°. If it were permitted to prolong this table up to zero we should find—

	Sp. Gr. at 0°.	V_m.
Solid resorcin	1·2728	86·43
Liquid resorcin	1·2923	85·13
Difference		1·30

Consequently the molecular volume would experience a dilatation of 1·3 in its passage from the solid to the liquid state. The molecular volume of resorcin, $C_{12}H_6O_4$, at the boiling-point, 276°, would be 103·17, a number almost identical with the molecular volume of phenol, $C_{12}.H_6.O_2$; calculated in the same manner the boiling-point, according to the assumption of H. Kopp, would be 103·6. However, this latter surpasses by 7·6 that of benzol, $C_{12}.H_6$, namely 96·0. The difference of composition, $C_{12}H_6.O_4 - C_{12}H_6O_2$ being the same as $C_{12}H_6O_2 - C_{12}H_6$, we see that this difference does not correspond to that of the molecular volumes. The comparison made at one and the same temperature, such as 100°, gives—

	Sp. Gr.	V_m.
Benzol	0·7938	98·26
Phenol	1·0128	92·90
Resorcin	1·2076	91·09

Here, again, phenol and resorcin have volumes very closely approaching, and very different from benzol. Resorcin on dissolving in water produces a sensible decrease of temperature; 100 grms. of water dissolve about (I say about because of the difficulty of determining by evaporation the weight of the dissolved resorcin)—

At 0°	86·4
At 12·5°	147·3
At 30·0°	228·6

—*Comptes Rendus.*

TITRATION OF OXALIC ACID AND OXALATES.

By MM. FERD. JEAN and H. PELLET.

The determination of free oxalic acid or of oxalates may be effected very exactly by the aid of baryta water and a standard solution of sulphuric acid; for this purpose we neutralise with care the solution to be assayed with a dilute solution of soda, and then add baryta water in a slight excess and filter. The filtrate is then mixed with seltz water, raised to a boil, separated by filtration from the carbonate of baryta, and in the clear liquid the alkali is titrated with standard sulphuric acid. 0·0777 grm. of SO_3HO = 0·1 grm. $C_2O_3,3HO$. 10 c.c. of a solution containing 1 per cent of C_2O_33HO required 11·8 c.c. of a standard acid, of which 10 c.c. = 0·066 grm. of SO_3HO, that is, 0·0778 of sulphuric acid; we then found 0·10001 grm. of oxalic acid instead of 0·1 grm. In another assay we obtained 0·0999 grm.

In order that this process of titration may give good results we must take care to separate the oxalate of baryta before adding seltz water; for this salt is very sensibly decomposed by carbonic acid, and if we do not take this precaution we shall be led into grave errors. We thought to have been able to apply this process to the titration of borates and tartrates, but the assays which we made with this view never gave good results. With boric acid it is impossible to seize the point of neutralisation, and the borates of baryta are all more or less soluble in an alkaline liquid. The tartrate of baryta is equally soluble in baryta water and in alkalies; there are formed, without doubt, double tartrates.—*Bulletin de la Société Chimique de Paris.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 7, 1877.

Dr. J. H. Gladstone, F.R.S., President, in the Chair.

After the announcement of visitors the minutes of the last ordinary and of the extraordinary general meeting were read and confirmed. The list of presents to the library was then announced, and the certificates of the following candidates were read for the first time: W. H. Martin and C. B. Fox, M.D. The President then gave notice that at the next meeting of the Society a ballot for the election of candidates would take place. The following papers were read;—

"*On the Gases Enclosed in Lignite Coal and Mineral Resin, from Bovey Heathfield, Devonshire*," by J. W. Thomas. Four samples were examined. No. 1 Lignite consisted of the leaves and stems of plants in a closely compressed condition, and is known locally as "leafy coal." No. 2 Lignite—dense, compact, of a distinctly woody character and dark brown. No. 3 Lignite was very dense, but earthy and wet in appearance, the cleavages being much encrusted with hydrated oxide of iron; in colour it was nearly black. No. 4. Mineral Resin Retinasphaltum—soft, brown, powdery, lighter than water.

No. 1. Leafy coal from Bovey Heathfield.—100 grms., after heating to 50° for twelve days, gave 56·1 c.c. of gas, containing—CO_2, 87·25; O, 0·24; CO, 3·59; OH_2, 8·92 per cent. After heating to 50° 100 grms. were heated to 100° for eighteen days, and yielded—59·9 c.c. of gas; CO_2, 89·53; C_nH_{2n} gases, 0·33; CO, 5·11; N, 5·03 per cent. On raising the temperature to 150° decomposition set in, and the pellets of mercury in the Sprengel became blackened by the formation of sulphide of mercury. The gas given off had at first an aromatic odour, but afterwards became exceedingly disagreeable from the presence of organo-sulphur bodies, mercaptan, sulphide of allyl, &c. At 200° more than 18 c.c. of gas were collected, the last portions of which contained CO_2, 82·06; H_2, 2·82; CO, 14·00; C_2H_4, 0·49; C_3H_6, 0·48; N, 0·27 per cent. Above 250° it was impossible to collect any gas, the action of the sulphur compounds on the mercury being so energetic as to block the Sprengel.

No. 2 Lignite—100 grms, at 50° evolved 48·5 c.c. of gas, consisting of—CO_2, 96·23; O, 0·11; CO, 2·42; C_nH_{2n} gases, a trace; nitrogen, 1·24 (the first portion of gas which came off contained 16·23 per cent N). At 100° sulphur sublimed in small yellow crystals; the lignite began to decompose at 185°. At 200° the gas consisted of CO_2, 86.30; CO, 7·41; C_nH_{2n} gas, 2·08; marsh gases, 3·34; hydride of propyl, 0·53; nitrogen, 0·34 per cent.

No. 3 Lignite began to decompose at 180°; the gas evolved at 200° consisted of SH_2, 0·41; CO_2, 91·68; C_nH_{2n}, 0·41; CO, 7·12; H, traces; N, 0·38 per cent.

No. 4. Mineral resin from Bovey Heathfield.—At 50° a very small quantity of gas was given off. At 100°, 21·4 c.c. of gas from 100 grms. came over; CO_2, 88·24; O, 0·23; C_nH_{2n}, 0·47; CO, 7·90; N, 3·16 per cent. At 110° to 120° it began to melt and decompose, the sulphur compounds coming off so rapidly as to block the pump. When the temperature was raised to 160°, about 180 c.c. came over, consisting of SH_2, 0·41; CO_2, 78·88; C_nH_{2n} gases 2·67; CO, 7·82; marsh gas 8·05; hydride of propyl, 1·86; nitrogen, 0·31. When compared with the coals of the carboniferous period, it is seen that, as far as the occluded gas is concerned, these lignites resemble most cannel coal, but contain C_nH_{2n} gases, and only matters of the aromatic series instead of gases and compounds of the paraffin series. The lignites are far less stable *in vacuo*, decomposing below 200°, whilst the true coals usually resist a temperature of 300°. The existence in Nos. 1 and 3 of organo-sulphur compounds in the presence of hydrated oxide of iron suggests that the iron pyrites of true coal may have derived their sulphur from that existing in organic combination in the plants from which coal is produced, and not from the reduction of sulphates. The author concluded by pointing out the extremely hygroscopic nature of the Bovey lignites. Mr. Thomas also exhibited two mechanical appliances driven by water or steam for shaking a beaker containing a precipitate so as to promote its settling or for hastening the solution of a substance. He mentioned that with the aid of the apparatus the magnesia precipitate came down from a dilute solution in fifteen to twenty minutes.

After the thanks of the meeting had been given to the author,

The President called on Dr. Frankland to read a paper on "*Apparatus for Gas Analysis*." After giving a short description of the original apparatus introduced by himself and the late Mr. Ward, the author proceeded to point out the various modifications the apparatus had met with at the hands of Mr. Duppa and Professor McLeod. Notwithstanding all improvements there were still some disadvantages connected with the apparatus. In the first place the bottom of the water cylinder was closed by an india-rubber cork, through which the two tubes passed; this cork after a time was liable to stick, and so on removal a risk of breakage was incurred; moreover, it was not rigid, so that when the measuring tube was filled with mercury the weight depressed the india-rubber cork to a slight extent. This defect the author proposes to remedy by substituting a cast-iron plate through which the glass tubes pass water-tight by means of suitable collars, and are clamped by a strong wooden clamp screwed to the cast-iron bottom; a stopcock is inserted into the cast-iron base for the introduction of water instead of passing it down a glass tube. Another defect of the old apparatus was the use of steel caps to unite the laboratory tube with the measuring tube; they are liable to rust, are expensive, form a rigid joint, are always liable to break away from the cement, and, unless very carefully ground, are difficult to make absolutely tight. The author therefore proposes to do away with the steel caps by the following contrivance:—The upper end of the measuring tube terminates in a small cup like a small funnel with a very acute angle. The tube from the laboratory tube is bent twice at right angles, and then drawn out at its end so as to fit into the neck of the above cup (without grinding). It is then covered with a piece of thin sheet unvulcanised india-rubber, the edges of which are cut cut off, warmed, and joined so that a conical stopper of india-rubber is formed; this, when moistened and pressed down into the cup by an india-rubber band and covered with mercury, forms a perfectly air-tight joint, which is nevertheless flexible.

Mr. Warington said the joint had been most severely tried, not only with regard to its tightness, but as regards the possibility of any air space being left between the capillary tube and the cup, but no perceptible error could be detected.

Dr. Frankland said there was another point which he had forgotten to mention, the rack and pinion of Regnault's apparatus was replaced by a long screw, the shelf for the mercury trough sliding on a V shaped guide, and having a nut to fit the screw. In answer to Dr. Wright, who asked if the india-rubber cone was greased or not to secure the tightness of the joint, Dr. Frankland said that the joint was only moistened with water.

Dr. Russell bore testimony to the necessity of wetting india-rubber and glass joints to secure their tightness. With regard to the improvements brought forward by Dr. Frankland, he would say that only those who had worked with the old apparatus could properly appreciate them.

Mr. Greenaway pointed out the great ease with which the laboratory tube could be cleared by reagents now that the steel caps had been god rid of.

Dr. Wright then read a paper on "*Narcotin, Cotarnin, and Hydrocotarnin*," Part V. A large number of experiments made with a view of breaking up cotarnin into simple bodies, and so to elucidate its structure, were as fruitless as were attempts made to synthesise narcotin from mixtures of hydrocotarnin and opianic acid. By acting on hydrocotarnin hydrobromide with bromine, the following actions take place:—

1. $C_{12}H_{15}NO_3, HBr + Br_2 = \underbrace{HBr + C_{12}H_{14}BrNO_3, HBr}_{\text{Bromhydrocotarnin hydrobromide.}}$

2. $C_{12}H_{14}BrNO_3, HBr + Br_2 = \underbrace{2HBr + C_{12}H_{12}BrNO_3, HBr}_{\text{Bromocotarnin hydrobromide.}}$

3. $C_{12}H_{12}BrNO_3, HBr + Br_2 = \underbrace{C_{12}H_{12}Br_3NO_3, HBr}_{\text{Tribromhydrocotarnin hydrobromide.}}$

The formation of the first two bodies is preceded by the production of the unstable addition products—

$$C_{12}H_{15}Br_2NO_3HBr \text{ and } C_{12},$$

and $C_{12}H_{14}Br_3NO_3HBr$ respectively; the third addition product, tribromhydrocotarnin hydrobromide, is a well defined crystalline stable substance. Bromhydrocotarnin and bromocotarnin resemble in general properties hydrocotarnin and cotarnin respectively. The first crystallises anhydrous and melts at 76°. The second is—

$$C_{12}H_{12}BrNO_3,H_2O,$$

and loses water at 100° with decomposition; their hydrobromides crystallise well, that of the first being sparingly soluble in H_2O and anhydrous, while that of the second is easily soluble, and contains $C_{12}H_{12}BrNO_3HBr,H_2O$. When heated to about 200° bromocotarnin hydrobromide fuses, gives off HBr and combustible vapours (apparently CH_3Br), and forms a small quantity of the hydrobromide of a new base termed "tarconin" (anagram on cotarnin and narcotin) $C_{11}H_9NO_3$, and a large amount of an indigo-blue substance, the hydrobromide of a base $C_{20}H_{14}N_2O_6$; this base and its salts are all but insoluble in water, ether, alcohol, benzene, CS_2, petroleum, &c.; boiling aniline and glacial acetic acid dissolve a minute quantity, forming a deep blue fluid; strong H_2SO_4 dissolves it, forming a sulphate $(C_{20}H_{14}N_2O_6)2H_2SO_4$. The solution has a tint rivalling magenta in beauty and intense colouring power. Tribromhydrocotarnin hydrobromide fuses at 200°, and decomposes in accordance with the reaction—

$$C_{12}H_{12}Br_3NO_3,HBr = HBr + CH_3Br + C_{11}H_8BrNO_3,HBr,$$

forming bromotarconin hydrobromide. Bromotarconin forms fine scarlet crystals, $C_{12}H_8BrNO_32H_2O$, which become crimson when dried at 100°. The crimson anhydrous mass, when dissolved in hot absolute alcohol perfectly free from water, separates on cooling in crimson crystals, but if the least trace of moisture be present, the scarlet hydrated crystals appear. The salts are pale yellow, well crystallised and sparingly soluble in cold water. The hydrochloride and hydrobromide contain $2H_2O$. Cotarnin hydrobromide is very soluble—

$$C_{12}H_{13}NO_3HBr_2H_2O;$$

with bromine it forms the addition compound dibromhydrocotarnin hydromide, $C_{12}H_{13}Br_2NO_3HBr$, which, by further action of Br produces tribromhydrocotarnin hydrobromide, identical with that from hydrocotarnin. By the action of water dibromhydrocotarnin hydrobromide splits up into HBr and bromocotarnin hydrobromide. By the action of zinc and hydrochloric acid bromocotarnin takes up H_2 and forms bromhydrocotarnin identical with that obtained by brominating hydrocotarnin. By acting on opianic acid with a large excess of HI almost the theoretical yield of CH_3I is obtained for the reaction—

$$C_{10}H_{10}O_5 + 2HI = 2CH_3I + C_8H_6O_5$$

(noropianic acid). The noropianic acid thus produced crystallises with $2H_2O$, and is not identical with the body recently described by Tiemann as isonoropianic acid.

The next paper was on "*Otto of Limes*," by C. H. PIESSE and Dr. WRIGHT. The otto from the rind of the fruit of the *Citrus limetta* had a sp. gr. of 0·90516 at 15·5° C. When distilled, about two-thirds passed over below 186°. After purification by fractional distillation and finally over sodium this yielded a terpene body boiling at 176°. On treating with bromine an unstable dibromide was formed, unlike the dibromide of the hydrocarbon from orange peel (hesperidene). This yielded but little cymene by simple heating, the greater portion being transformed into resinous non-volatile bodies. The cymene thus produced boiled at 176°, and yielded terephthalic and acetic acids by oxidation with chromic acid; hence it would seem that the terpene of the lime is not identical with that of the orange, nothwithstanding the nearness of their boiling-points, but that it is more like the terpene of the lemon (boils about 173°), which, as Openheim has shown, yields a dibromide from which but small quantities of cymene are formed by simple heating. The residue not volatile at 186° was further heated, and gave a few drops of distillate between 186° and 250° The residue in the retort was a semi-solid resin. On standing two or three months a quantity of crystals formed in this soft mass. These were extracted by the pump filter, well washed with the terpene and with alcohol, and crystallised successively from strong and dilute alcohol. They formed white micaceous plates, scentless, neutral, not volatile without charring, giving numbers agreeing with the formula $C_{24}H_{28}O_5$, melting at 162°, not forming protocatechuic acid on fusing with potash, and therefore not identical or even allied to hesperidin.

Mr. GROSJEAN pointed out that in Sicily the otto was collected by powerfully squeezing the rind of the lime against a clean sponge. He objected to the formation of new names for chemical substances by the anagrammatic method.

The Secretary, Mr. PERKIN, then read a paper by Mr. C. T. CROSS on "*Primary Normal Heptyl Alcohol and some of its Derivatives.*" Pure œnanthol was prepared by a rapid dry distillation of castor oil and fractional distillation. Its sp. gr. was 0·823 at 16° C.; at 748·6 m.m. it boiled at 152°. Heptyl alcohol was prepared by acting on 15 grms. of œnanthol dissolved in 150 grms. of 65 per cent acetic acid with 10 grms. of sodium in 1000 grms. of mercury for ten days; the alcohol was drawn off, washed, &c., and purified by fractional distillation. From 300 grms. of impure aldehyd 120 grms. of pure alcohol, boiling 170° to 180°, were obtained. Some of the alcohol was specially purified by rectification over metallic sodium. It is colourless, has an agreeable pear-like odour; sp. gr. at 0° 0·833, at 16° 0·830, at 27° 0·824, at 764·1 m.m. it boiled at 175·5°. The following substances were also prepared:—

	Sp. Gr. at 16°.				
Heptyl chloride ..	0·881,	boils	754·0	m.m. at	159·200°
,, bromide ..	1·133,	,,	750·6	,,	178·500
,, iodide ..	1·346,	,,	754·8	,,	201·000
,, acetate ..	0·874,	,,	758·5	,,	191·500
,, œnanthylate	0·870,	,,	760·0	,,	270·272
,, ethylether ..	0·790,	,,	748·3	,,	165·000

In conclusion the author draws attention to the coincidence of the boiling-points of the above compounds with those calculated by Schorlemmer, viz., chloride 158, bromide 179, iodide 202, acetate 191·5.

A short note was then read by the SECRETARY, from Messrs. DALE and SCHORLEMMER, "*On the Transformation of Aurin into Rosanilin.*" Since their last communication to the Society (May 24) on this subject the authors have compared the spectra of the hydrochlorides of their base and of rosanilin, and find them quite identical. They have transformed their base into Hofmann's violet, aniline-blue, and aniline-green, obtaining at the same time with the latter the violet. If aurin be heated with alcoholic ammonia for several days to 150° the rosanilin first formed is converted into leucanilin. A similar action does not take place in the formation of rosanilin from aurin, because rosanilin is readily formed by heating aurin with aqueous ammonia to 120° for twenty hours. If the temperature be raised to 180° to 200° other colourless bodies are formed.

The Society then adjourned to June 21, when the following papers will be read:—1. "On Diamyl," by H. Grimshaw; 2. "On Dinaphthyls," by Watson Smith; 3. "On certain Relations between the Oxalates and Carbonates of the Alkalies and Alkaline Earths," by Watson Smith; 4. "Note on Thallious Platino-cyanide," by R. J. Friswell and A. J. Greenaway; 5. "On Crystallised Barium Silicate," by E. W. Prevost; 6. "Note on Anethol and its Homologues," by W. H. Perkin.

PHYSICAL SOCIETY.

June 9th, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected members of the Society:—Mr. W. H. Northcott and Mr. L. J. Whalley.

Mr. S. P. THOMPSON read a paper "*On Interference Fringes within the Nicol Prism.*" After referring to the original paper by the inventor in 1828, in which this phenomenon was referred to, he gave a general description of it prior to explaining the cause. If the field of a Nicol be explored by the eye it will be seen to be bordered on one side by a margin of violet-blue light, and on the other, when the light passes obliquely through the prism, by an orange band within which lie a series of coloured fringes; these latter are very clearly seen with monochromatic light when a second set within the blue band also appears. The author showed that these two sets are due to interference taking place within the film of balsam at the critical angle of total reflexion for ordinary and extraordinary rays respectively; they are therefore analogous to the interference bands in a thin film placed beneath a prism of a more highly refracting substance, and occurring just within the limit of total internal reflexion, as first observed by Sir W. Herschel.

At the conclusion of the scientific business of the Society, a special general meeting was held.

ERRATUM.—On page 207, column 2, line 7 from bottom, *for* "more" *read* "less."

NOTICES OF BOOKS.

Qualitative Chemical Analysis. By Professors S. H. DOUGLAS and A. B. PRESCOTT. Second Edition, pp. 254. New York: D. van Nostrand. London: Trübner. 1876.

THIS book is in reality, as its second title affirms, a guide in the practical study of chemistry and in the work of analysis. It is not a mere body of directions, to be blindly followed by the student without his having learnt the reason why. If this book be faithfully studied, the habits of "automatic operation" and "superficial observation"—too often the only acquirements learnt in a laboratory—will be accompanied by a sound knowledge of the *principles* on which the plans of qualitative analysis are based. Indeed, if we had before us for review nothing but one more mere manual of analysis, distinguished from the ever-increasing crowd of such manuals to which the attention of teachers and learners is being continually called, by no distinctive superiority, we doubt whether our readers would have thanked us for noticing the book. But the volume before us shows so many marks of ability in its conception, and care in its execution, that it is a real pleasure to speak decisively in its favour.

In criticing a volume on chemical analysis, the minuter details of the treatment adopted would be out of place. But we may give our readers a summary of the contents of the book, and we may also convey some notion of the style in which the subject is handled in a very few lines. After a few preliminary remarks, very sound and intelligible, on the study of chemical analysis, we reach the two chief chapters of the book, relating to the reactions of the metals and acids, respectively. Here the rarer metals and non-metals are introduced, but the rarer organic acids are excluded as not admitting of adequate discussion in a manual for student's use. Indeed, if we include such organic acids as succinic and salicylic in a handbook of ordinary qualitative analyses, such organic bases as methylamine and quinine can scarcely be omitted. Nearly two hundred pages are thus occupied with what may be called the *comparative* chemistry of the metals and bases, of the non-metals and acids. There is no shirking of explanations. Reactions are duly displayed, while a running commentary explains at once why certain properties and changes are utilised in the processes of separation, and also how this is done. That the reactions are chronicled with adequate fulness may be gathered from a single example which we take, haphazard, from the account of iron compounds, which occupies more than five pages (47 to 52):—

"Iron dissolves, in hydrochloric acid and in dilute sulphuric acid, to ferrous salts, with liberation of hydrogen (*a*); in moderately dilute nitric acid, with heat, to ferric nitrate, liberating chiefly nitric oxide (*b*); in cold dilute nitric acid, forming ferrous nitrate with production of ammonium nitrate (*c*), of nitrous oxide (*d*), or of hydrogen (*e*):—

a. $Fe + H_2SO_4 = FeSO_4 + 2H$
b. $2Fe + 8HNO_3 = Fe_2(NO_3)_6 + 2NO + 4H_2O$
c. $4Fe + 10HNO_3 = 4Fe(NO_3)_2 + NH_4NO_3 + 3H_2O$
d. $4Fe + 10HNO_3 = 4Fe(NO_3)_2 + N_2O + 5H_2O$
e. $Fe + 2HNO_3 = Fe(NO_3)_2 + 2H$."

After the foregoing reactions and plans of separation we find a concise account of the "Preliminary Examination," including blowpipe analysis; then follows the systematic analysis of solutions, and a full account of the solubilities of salts. The two pages (245-6) devoted to Reagents do not suffice for a useful discussion of this subject.

CORRESPONDENCE.

DE HAËN'S PROCESS.

To the Editor of the Chemical News.

SIR,—Although your journal has brought some weeks ago an answer to an inquiry on the above process, I trust you will allow me to say a few words on the subject, which, in my opinion, deserves to be widely known and introduced. Several years ago De Haën's process for treating water so as to prevent the formation of incrustations in boilers was brought under my notice by Messrs. Domeier and Co., of 3, Botolph Lane, who represent Mr. De Haën in this country, and who, I make no doubt, will gladly answer any inquiry.

For more than four years the process has been largely used in Germany, not only in a great many factories, but also at several large railway stations, where the engine-boilers are fed, and once introduced it has invariably given entire satisfaction. Professors Heeren, Karmarsch, and Ruhlmann have practically tested the modes of purification and its effects, and strongly recommend it.

I think Mr. Payne, in his letter, is not quite correct in saying there is nothing new in the plan, and as he has made some important additions I, for one, regret he has not placed these additions before the readers of your journal.

Mr. De Haën does not claim any particular merit for a new invention. He frankly states that one of his objects in view is a new application of barium chloride, and the extremely large quantities of the salt sold for the purpose prove his success; he also points out the importance of the purity of the salt, and as its manufacture forms one of his specialities he is ready to furnish practical information for its new application. The removal and conversion of the lime salts which form the incrustation by the combination of lime and barium chloride appears to be simple and

perfect; and I cannot agree with Mr. Payne as to the difficulty arising from the character of the men employed as stokers.

The operation does not require any particular skill; the necessary quantity of barium chloride is readily determined by a simple test, and if this should be inconvenient a few ounces of the water may be sent either to Messrs. Domeier and Co. or myself, who will give the desired information.

The additional trouble is very trifling, and will, I believe, disappear if compared with the serious annoyance, waste of fuel, and loss of time consequent upon the periodical removal of the incrustation and the damage done to the boilers.—I am, &c.,

FREDERICK VERSMANN, Ph.D.

35, Whitecross Place, Wilson Sreet, Finsbury, London, E.C., June 6, 1877.

DE HAEN'S PROCESS.

To the Editor of the Chemical News.

SIR,—I am obliged by the kind letter of Mr. Alfred Payne, F.C.S., replying to my inquiry in your issue of May 11, and trust he will accept my thanks.

I have lately read with much pleasure the able paper of Mr. F. G. Rowan "On Boiler Incrustation and Corrosion," read before Section G, British Association, at the recent meeting in Glasgow in September, 1876. The facts and results of observations therein recorded are most valuable and interesting and in every way practical. The following paragraph on page 11 of his pamphlet, which reads as under, however, drew my attention:—

"Two other methods of prevention have also been devised, and seem to be founded upon the fact which, Professor Mills informs me, was first observed by J. Y. Buchanan (*Proc. Royal Soc. of London*, 1873-4, vol. xxii., pp. 192 and 483), that barium chloride decomposes sulphates and liberates the carbonic acid in water. One of these, called 'De Haën's process,' which consists in the use of barium chloride and milk of lime, is now extensively used in Austria and in Krupp's Works in Prussia."

From the preceding extract it would seem as though the De Haën's process had the claim of priority in the use of barium chloride as a preventive against boiler incrustations, and the above paragraph in Mr. Rowan's pamphlet tends to give one rather the impression that the use of the salt for this purpose was not known or practised until very recently. It should be stated, however, that the application of this reagent has been known for many years past. I am not aware how many parties have used this reagent for the object described above; but it is not improbable that others besides myself may at various times have done so.

I successfully tried it at the Wortley Ironworks and Wortley Silkstone Colliery for this object some nine years ago during the year 1868. The cost of the barium salt then as compared with soda-ash being, however, an obstacle to its continued use, as from the bad nature of the water, so much was required, and soda-ash appeared to answer the purpose of a preventive equally well, if not in some respects better, and was found to be cheaper.

Being much inconvenienced for want of a good supply of pure water for boilers at the Wortley Silkstone Colliery, we had chiefly to depend for supplies on the water pumped from the mine, which was, in fact, a mineral water most unfit in every way for this purpose; but which, except in very wet weather, we were compelled to use for the simple reason that none other could be got.

The following determinations of the sulphates made at various times show the unsatisfactory character of this water for boiler purposes. It has also a strong acid reaction with litmus.

Determinations of Sulphates in Water from Wortley Silkstone Colliery; Results Calculated as (Sulphuric Anhydride) SO_3.

Date.	Results in Grains per Gallon. Dry Seasons.	Rainy Seasons.
June 20, 1865	—	27·90
October 12, 1867 ..	—	45·63
November, 1868 ..	—	67·91
March 3, 1875	119·00	—
,, 5, 1875	101·63	—
,, 10, 1875	96·62	—
February 1, 1876 ..	103·55	—
,, 15, 1876 ..	—	68·33
,, 26, 1876 ..	—	78·55
,, 28, 1876 ..	—	76·29
March 6, 1876	—	81·10
,, 10, 1876	—	88·38
July 26, 1876	134·18	—
,, 27, 1876	137·48	—
	6) 692·46	8) 534·09
Mean average	115·41	66·76

The sulphates were chiefly those of calcium, magnesium, and iron, and all the samples had an acid reaction with blue litmus, those collected during *dry seasons* being *strongly* acid.

From the above series of determinations it will be seen that the character of the water becomes worse as time goes on. The incrustation deposited from this water in the boilers gives the following composition, from which it will be seen that the chief ingredient is calcium sulphate:

Moisture	6·85 per cent.
Combined water, organic matter, &c.	5·80 ,,
Siliceous matter	1·80 ,,
Peroxide iron and alumina	6·10 ,,
Phosphoric acid, 0·76	
Sulphate of lime	78·55 ,,
Magnesia	0·65 ,,
	99·75

The interiors of the boilers had thick hard crusts continually deposited on them, which could only be hammered off with difficulty, and the boilers had to be very frequently "blown off" with a view to getting rid of as much scale and sediment as possible. As may be presumed the cost of repairing these boilers has always been considerable, and in order to obviate as much as possible the evils arising from the use of this bad water, various artificial remedies have been tried, as for instance, chloride of ammonium process, carbonate of ammonia, soda-ash, &c. Seeing that the chief obnoxious constituent to be got rid of was calcium sulphate, and not improbably some little sulphuric acid free, it occurred to me that the most effectual means of doing this would be to commence using barium chloride, which was accordingly done and with very good success. As before stated the chief reason for its discontinuance being the expense of the barium salt used as compared with soda-ash. The method of employing the barium chloride was as follows:—

The feed water was first run into a large tank or dam made near the boiler house; the dissolved barium chloride was then added in quantity about sufficient to precipitate the sulphates; the heavy white precipitate of barium sulphate formed, then allowed to subside to the bottom of the tank, which it quickly did owing to its great weight, and the clear water then run off into a reserve tank, for use in the boilers, which, during the continuance of this process, remained tolerably free from deposit or incrustation of any kind; but if through any carelessness of the stoker the precipitated barium sulphate was allowed to get into the boiler it quickly adhered to the sides and formed a hard crust difficult to be removed. Therefore, so far as my experience goes, I have always found a con

siderable advantage in using what we may call a precipitating tank, and I believe De Haën claims this use of a precipitating tank as one of the essential principles of his process, but he cannot be said to have priority in this.

The precipitating tank is still continued, although soda-ash instead of barium chloride is now used, as by this means the sediment is got rid of before it enters into the boilers—a matter of importance; and in all cases where bad water is of necessity obliged to be used, it will be found both economical and in every way satisfactory to use tanks for the above purpose.

I take the liberty of writing you mentioning this matter, as from the paragraph in Mr. Rowan's pamphlet an erroneous impression might be produced that barium chloride had not been used as a preventive for boiler incrustation previous to the publication of the interesting and valuable researches of J. Y. Buchanan in *Proceedings of the Royal Society*, vol. xxii., 1873 and 1874.—I am, &c.,

THOS. ANDREWS.

DOCTORS' DIPLOMAS.

To the Editor of the Chemical News.

SIR,—Dr. P. Townsend Austen requests me to publish the proof of my statement that the degrees sold by "Medicus" are of the University of Philadelphia.

Some three years ago one or two letters were published exposing the degrees sold by "Medicus," and it was said even then that the University had lost its Charter. At the end of 1874 I noticed that "Medicus" was still advertising, and curious to know what kind of degrees he had to offer I applied to him for a German Ph.D., though aware that the traffic in these degrees had ceased. He answered that he could get me a Ph.D. and M.A. of the University of Philadelphia, and that on sending him £20 I should receive a handsome diploma in order. At the same time he sent me a printed list of the lectures and lecturers at that university.—I am, &c.,

A. A. R.

London, June 9, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 20, May 14, 1877.

Rotatory Action of Quartz upon the Plane of Polarisation of the Dark Heat-rays.—M. P. Desains.—Not adapted for useful abstraction.

Analysis of an Ancient Wine Preserved in a Glass Vessel Sealed by Fusion.—M. Berthelot.—The liquid is yellowish, and contains a solid matter held in suspension, which does not deposit on long standing. The liquid, however, can be clarified by repeated filtrations. The yellowish brown deposit does not contain resin or other characteristic matter, and results doubtless from the slow alteration of the original colouring matter. The liquid possesses a distinctly vinous odour, distinctly aromatic, and recalling that of wine which has been in contact with fatty matters. The flavour is hot and strong, by reason of the simultaneous presence of alcohol, acids, and a trace of aromatic matter. The analysis shows per litre—Alcohol, 45·0 c.c.; fixed acids (estimated as free tartaric acid), 3·6 grms.; bitartrate of potassa, 0·6 grm.; acetic acid, 1·2 grm.; tartrate of lime in distinct traces; traces of acetic ether; no decided indication of chlorides or sulphates. No colouring matter existed in the liquid, at least not in a proportion sufficient to be modified by alkalies or precipitated by acetate of lead. There were mere traces of sugar, or rather of matter capable of reducing cupro-potassic tartrate.

Origin and Nature of Typhoid Fever.—M. J. Guerin.—This paper is of a purely medical nature.

The Otheoscope, a New Modification of the Radiometer.—Mr. W. Crookes.—The contents of this paper are already known to readers of English scientific journals.

Direct Conversion of Mechanical Work into Electricity.—M. E. Guignet.—The Polytechnic School of Rio Janeiro possesses an electro-motor formed of five fixed electro-magnets, and of a movable drum furnished with six bars of soft iron. The current of ten Bunsen elements being passed along the wire of the electro-magnets the drum revolves quickly. This apparatus has long been employed to show how a current of electricity, whatever its origin, may act as a motive power. The same apparatus may serve for the inverse demonstration. If the two ends of the wire of the electro-magnets are connected with a galvanometer, and if the apparatus is turned by hand, a continuous current is produced.

Note on Chemical Researches carried on at the Polytechnic School of Rio de Janeiro.—M. E. Guignet.—The author is engaged with an investigation of the nickeliferous iron of Santa-Catarina. On treating a large quantity of this mineral with aqua regia a crystalline residue was obtained resembling osmide of iridium, but which is simply phosphide of iron (and nickel?). He is also occupied with a curious substance of a mineral aspect, but of a resinous nature, found deposited within the trunks of *Angelim pedra*, in the province of Minas Geraes. The cinchonas of Theresopolis are also under examination. At the experimental gas works of the school trials are being made with the bituminous schists of Bahia, the coal of Tubárao, and the lignites of Cacapava.

Researches at the School of Mines of Ouro Preto.—M. H. Gorceix.—The author is seeking to explain the formation of the topaz and the euclase and the origin of the diamond.

Certain Monochloric Acids of the Acrylic Series.—M. E. Demarcay.—The author has been studying the monochlorated methyl-crotonic, ethyl-crotonic, isopropyl-crotoaic, and propyl-crotonic-acids.

Salts of the Sesquioxide of Chrome.—M. A. Etard. The only crystalline sulphate of chrome hitherto known is the violet sulphate to which Schrœtter gives the formula $Cr_2(SO_4)_3 15H_2O$. This formula—differing by three molecules of water at least from that of the sulphate of alumina, $Al_2(SO_4)_3, 18H_2O$—may seem exceptional if we take into account the analogies and the isomorphism which generally prevail between the salts formed by the sesqui-salts of chrome and alumina. Without denying the possible existence of a salt with $15H_2O$ which may be obtained by other methods, the author has sought for a sulphate with $18H_2O$, which he regards as normal, and finds that it may be easily prepared by allowing the vapours of ether to react upon a solution of 100 parts CrO_3 in 150 parts of sulphuric acid and 225 of water. The chromic sulphate thus obtained is a fine violet salt, permanent in the air, and of a well defined composition. If dried in the open air its composition is $Cr_2(SO_4)_3 18H_2O$. At 100° it loses 30·5 per cent of its weight, and, parting with 12 H_2O, it is converted into the green crystalline sulphate $Cr_2(SO_4)_3 6H_2O$. This latter salt, which is deliquescent, loses its six molecules of water at dull redness, and becomes the anhydrous sulphate, $Cr_2(SO_4)_3$. Hence the violet sulphate may be formulated as—

$$[Cr_2(SO_4)_3 6H_2O]12Ag.$$

From the comparison of these formulæ it would seem that the differences between these two varieties are the result of a super-hydration of the violet salt. Along with chrome alum, regarded in its anhydrous state as $Cr_2(SO_4)_4K_2$, may

be ranked a crystalline and well-defined salt of the formula $Cr_2(SO_4)6K_6$, or in equivalents $Cr_2O_33SO_3.3KO,SO_3$. This salt, which is very stable, represents a molecule of anhydrous sesquichloride of chrome, Cr_2Cl_6, in which the chlorine is replaced by residues of bisulphate of potassa, $Cr_2(SO_4K)_6$. The bisulphate of potassa acting as a true monobasic acid, the author proposes to call the new double salt potassio-sulphate of chrome. It is easily obtained by putting small portions of the anhydrous chloride, Cr_2Cl_6, into melted bisulphate of potash, and heating to redness for a few minutes. A sodio-sulphate of chrome and a potassio-sulphate of iron may be obtained in an analogous manner. In these salts the relations between the acid of the sesqui-sulphate and that of the alkaline salt are the same, exactly as in the series of double salts known as magnesian; $Cr_2(SO_4)_3,3SO_4K_2$, potassio-sulphate; $(MgSO_4)_3,3SO_4K_2$ (triple magnesian sulphate).

Researches on Pseudo-purpurin: a Sequel to Researches on the Colouring Matter of Matter.—M. A. Rosenstiehl.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 1, May 3, 1877.
This issue contains no original chemical matter.

MEETINGS FOR THE WEEK.

TUESDAY, 19th.—Zoological, 8.30.
WEDNESDAY, 20th.—Geological, 8.
—— Meteorological, 7.
THURSDAY, 21st.—Royal, 8.30.
—— Chemical, 8. "On Diamyl," Mr. H. Grimshaw. "On Dinaphthyls," Mr. Watson Smith. "On Certain Reactions between the Oxalates and Carbonates of the Alkalies and Alkaline Earths," Mr. Watson Smith. "Note on Thallious Platino-cyanide," Messrs. R. J. Friswell and A. J. Greenaway. "On Crystallised Barium Silicate," Mr. E. W. Prevost. "Note on Anethol and its Homologues," Mr. W. H. Perkin.
—— Royal Society Club, 6.30. (Anniversary.)
—— Philosophical Club, 6.30.
FRIDAY, 22nd.—Quekett Club, 8.
SATURDAY, 23rd.—Physical, 3.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 917.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 245.)

148. I HAVE proposed for this instrument the name of the *Radiometer*, as it serves to measure the amount of radiation falling upon it by the velocity with which it revolves. It may also be called the *Light-Mill*. The rapidity of revolution is directly proportional to the intensity of the incident rays. Several radiometers, of various constructions, were exhibited at the Soirée of the Royal Society on April 7th, 1875. The following experiments have been tried with radiometers of different kinds and very varying sensitiveness. I could easily have obtained better curves and closer accordance with theory by repeating some of the observations with more recent instruments; but the results already obtained are sufficient to prove the laws, and I could do no more than this were I to repeat the experiments.

As soon as the radiometer was seen to revolve it was apparent that the stronger the light the more rapid was the movement. The second instrument which was made, the vacuum being very imperfect, the moving parts (straw arms and pith surfaces) heavy, and the instrument accordingly comparatively insensitive, was mounted for the purpose of testing its action at different distances.

FIG. 7

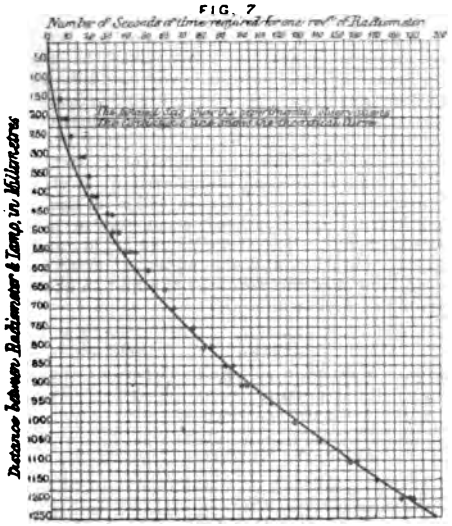
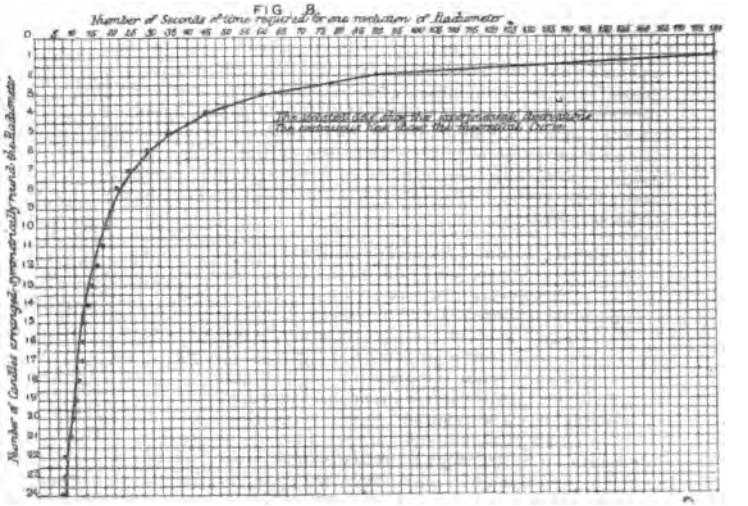


FIG. 8


Number of Seconds of time required for one revolution of Radiometer
Number of Candles arranged symmetrically round the Radiometer

The radiometer was covered with a thin glass shade, and in front of this was a large sheet of plate glass. The whole was covered on three sides and the top and bottom with black velvet, the fourth side admitting the light from the lamp. The source of light was one of Dietz's paragon lamps, burning paraffin oil. This lamp I find gives the brightest light and steadiest flame of any I have tried. Black velvet screens were put round the lamp, except on the side facing the radiometer. The room was darkened, and the temperature was kept uniform. The radiometer was kept fixed, and the lamp was moved backwards and forwards along a graduated scale, the number of seconds required for the radiometer to make one revolution being recorded by a chronograph watch. The following Table gives the results:—

Distances between Radiometer and Centre of Lamp-flame, in Millimetres.	Number of Seconds of Time required for the Revolution of the Radiometer.
150 millims.	6 seconds.
200 ,,	8, 9 ,,
250 ,,	11 ,,
300 ,,	15, 16 ,,
350 ,,	20 ,,
375 ,,	21 ,,
400 ,,	23, 24 ,,
450 ,,	29, 31 ,,
500 ,,	34, 36 ,,
550 ,,	40, 42, 44 ,,
600 ,,	52 ,,
650 ,,	60 ,,
700 ,,	65 ,,
750 ,,	74 ,,
800 ,,	82, 84 ,,
850 ,,	93, 95 ,,
900 ,,	100, 102 ,,
950 ,,	116 ,,
1000 ,,	129 ,,
1050 ,,	140 ,,
1100 ,,	158 ,,
1150 ,,	170 ,,
1200 ,,	184, 188 ,,

The diagram fig. 7 shows the curve formed by these observations. The isolated dots show the experimental observations, and the continuous line gives the theoretical curve which ought to have been followed according to the law of inverse squares. They are sufficiently concordant to show that this is the law governing the movements of the radiometer. The diagram illustrating this was laid before the Royal Society on April 22, 1875; I therefore prefer to retain it rather than prepare another one with a more sensitive instrument.

149. I next wished to ascertain if the speed of rotation would increase directly with the number of candles, the same distance off, shining on the instrument.

The same radiometer that was used in the last experiment was placed in the centre of a circle, 2 feet diameter, having 24 standard candles arranged symmetrically round

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

the circumference. All the candles were lighted at first, and the times of revolution taken as they were removed one by one.

Number of Candles Burning 1 foot off.	Number of Seconds required for one Revolution of Radiometer.
24	6·4 mean.
23	7 ,,
22	7·5 ,,
21	8·5 ,,
20	9·5 ,,
19	10 ,,
18	11 ,,
17	11·3 ,,
16	12 ,,
15	13 ,,
14	13·3 ,,
13	14·5 ,,
12	16 ,,
11	17 ,,
10	18·5 ,,
9	19·7 ,,
8	21 ,,
7	23·5 ,,
6	28 ,,
5	35·5 ,,
4	44·5 ,,
3	59 ,,
2	92 ,,
1	180 ,,

The diagram shown in fig. 8 gives these observations, with the theoretical curve. Like the last one, this diagram was handed in to the Royal Society on April 22, 1875.

With a recently made instrument I should have been able to obtain better results. A radiometer now before me will revolve once in eight seconds to the light of a candle 1 foot off, whilst 24 candles make it spin with such velocity as to become almost invisible.

150. From the construction of the radiometer it is evident that the position of the light in the horizontal plane is of no consequence, provided the distance is not altered. This was tested during the last-described experiment. When a candle had to be removed, it was found to make no difference from what part of the circle it was taken. The following experiments were tried to further verify this result, the radiometer being a different one from that last used :—

	Seconds.
1 candle, placed 1 foot from centre of radiometer, gave 1 revolution in 78 seconds (78×1=)..	78
2 candles, placed 1 foot from centre of radiometer and put close together, gave 1 revolution in 39·5 seconds (39·5×2=)	79
2 candles, placed opposite to each other, gave 1 revolution in 39 seconds (39×2=)	78
3 candles, close together, gave 1 revolution in 26·5 seconds (26·5×3=)..	79·5
3 candles, spread round circumference, gave 1 revolution in 26 seconds (26×3=)..	78
4 candles, close together, gave 1 revolution in 19 seconds (19×4=)	76
5 candles, close together, gave 1 revolution in 16 seconds (16×5=)	80
5 candles, spread round circumference, gave 1 revolution in 15·5 seconds (15·5×5=)	77·5

151. I wished now to ascertain what would be the effect of bringing a radiometer into a uniformly lighted space, so that there should be no difference of action on any side.

A radiometer was covered over the top with a large sheet of paper, and the light from an argand gas-burner was reflected vertically downwards on to the paper. The apparatus was arranged so that, as near as possible, exactly the same amount of light should illuminate the instrument all round. The arms revolved at a uniform speed of one revolution in six seconds, and kept on at this rate as long as the experiment lasted.

A radiometer was taken on to the roof of the house, where there was an almost uninterupted view all round. The sky was of a uniform dull leaden colour, a cold north-east wind was blowing, and, as far as the eye could judge, there was no difference in the amount of light received from any quarter of the sky. The radiometer was covered with a white handkerchief, to still further diffuse the light. In this condition the arms made one revolution in an average of 1·9 second. On shading the light from the south the time of revolution was 2·7 seconds. On shading it from the north the time was one revolution in 2·9 seconds. With the west shaded off it was one in 2·3 seconds; and with the east shaded off, the rate was one in 2·9 seconds.

The same radiometer, exposed near a south-east window in a room in the afternoon of the same dull April day, revolved once in 16 seconds.

[The radiometer shows a striking difference between heat and light, as commonly expressed. Brought into a uniformly *heated* space, the instrument comes to rest as soon as it has acquired the temperature of the space; but brought into a uniformly *lighted* space (151) it continues revolving as long as the light lasts.—Received January 10, 1876.]

(To be continued.)

RESEARCHES ON EMERALDS AND BERYLS.*

PART II.—ON SOME OF THE PROCESSES EMPLOYED IN THE ANALYSIS OF EMERALDS AND BERYLS."

By C. GREVILLE WILLIAMS, F.R.S.

WHILE analysing the beryl "A" from Ireland, frequently mentioned in the first part of this investigation,† so many unexpected phenomena presented themselves to the author that he found it necessary to study carefully all the processes which have been published for the separation of glucina from alumina. On consulting the numerous papers on the subject, it became apparent that a wide difference of opinion existed amongst chemists as to the best method of working. Among the eleven or twelve methods which have been proposed for the purpose, there are three which have been especially employed in the most important researches. These are placed below, and under each heading will be found the names of some of the chemists who have used the process; the first in each case being that of the inventor.

Carbonate of Ammonium.	Hydrate of Potassium.	Chloride of Ammonium.
Vauquelin.. 1798.	Vauquelin .. 1798.	Berzelius 1812.
Klaproth .. 1801.	C. G. Gmelin 1840.	Weeren 1854.
Lewy .. .. 1857.	Awdejew .. 1843.	
Hofmeister 1859.	Damour .. 1843.	
	Ebelmen .. 1848.	

The author's paper is devoted to a study of the first of these, namely, the carbonate of ammonium process.

The following are the principal questions or problems which he has endeavoured to solve :—

1. Is glucina permanently soluble in a solution of carbonate of ammonium?
2. Does glucina confer its solubility on alumina, or does alumina confer its insolubility on glucina?
3. With what amount of accuracy can a mixture of glucina and alumina be separated by means of carbonate of ammonium?
4. How do solutions of glucina and alumina behave with carbonate of barium?

* Abstract of a Paper read before the Royal Society, April 26, 1877.
† *Proc. Royal Soc.*, No. 145, 1873.

I. *Is Glucina Permanently Soluble in a Solution of Carbonate of Ammonium?*

This question is of paramount importance, because if glucina once dissolved in carbonate of ammonium is liable to assume an insoluble condition and separate from the solution, it introduces a complication into the process, the effect of which it is difficult to estimate. Joy* states that "If the solution be kept longer than ten days a precipitate of carbonate of glucina will begin to form, and at the expiration of sixteen days 15 per cent less of the original amount will go (*sic*) into solution." This assertion of Joy's caused the author some perplexity at first, as he had during many years repeatedly dissolved glucina in solution of carbonate of ammonium, but had never observed a deposit to take place *unless he had reason to suspect the presence of alumina*. He therefore resolved to submit pure glucina, and mixtures of that earth with alumina, to repeated quantitative experiments, with the view of deciding the question.

Experiment I.—0·6943 grm. of glucina, which had already been partially purified by solution in carbonate of ammonium, was dissolved in hydrochloric acid; ammonium hydrate was then dropped in until the solution was very nearly neutral, and 138 c.c. of solution of carbonate of ammonium were added.† At first nearly everything was dissolved, but a precipitate soon commenced to form. This is quite characteristic of the presence of alumina. The solution was filtered next day, and the precipitate was collected, washed, dried, and burnt with all the usual precautions. The weight of the alumina was 0·0058 grm., or 0·84 per cent on the glucina taken. The solution was put aside in a well-stoppered bottle, with the intention of filtering it in sixteen days; but as much more than that time passed without a precipitate forming, it was put away carefully for *three years*. At the end of this time the bottle, on being shaken, showed a barely perceptible trace of deposit; nevertheless, it was filtered off with every precaution and was found to weigh 0·0038 grm., or 0·55 per cent, and this was probably partly alumina and partly silicate, arising from a slight decomposition which had taken place of the glass of the bottle.

Experiment II.—0·2140 grm. of the glucina which had remained three years in solution was next experimented on. The earth was dissolved and heated as before with 50 c.c. of carbonate of ammonium solution. In ten minutes after being well agitated all but a few imponderable flocks were dissolved. In fifty minutes they were scarcely visible. Two days after they had totally disappeared. In sixteen days, the period at which Joy says 15 per cent less of the glucina will remain in solution, the liquid was filtered and yielded 0·0023 grm. of precipitate, or 1·07 per cent, a quantity which might partly arise from insufficient washing, partly from a variation from the mean weight in the filter-ash, and also from a trace of alumina.

Experiment III.—0·1603 grm. of glucina known to contain a little alumina was dissolved in hydrochloric acid, neutralised as usual, and treated with 50 c.c. of solution of carbonate of ammonium. The residue of alumina weighed 0·0071. In two days 0·0067 grm. more was obtained. On filtering sixteen days afterwards only 0·0017 grm., or 1·06 per cent, was obtained. In one year after that time the solution was again filtered, the deposit weighed 0·0012 grm., or 0·75 per cent, being only one-third of the weight of the ash of one filter paper.

Experiment IV.—0·3846 grm. of *pure* glucina was treated in the usual manner with 80 c.c. of carbonate of ammonium solution. The whole dissolved perfectly in a few minutes. The solution was kept for three weeks and then filtered. The precipitate weighed 0·0003 grm., or 0·08 per cent, after deducting the filter-ash. These experiments lead the author, therefore, to affirm unhesitatingly that *one decigrm. of pure glucina is permanently soluble in 25 c.c. of a saturated solution of carbonate of ammonium.*

It was necessary, in order to make these experiments complete, to ascertain whether great variations in temperature influenced the solubility of glucina in solution of carbonate of ammonium. That glucina was permanently soluble at about 15° C. there remained no doubt, but there might still be a tendency in glucina to assume an insoluble form at higher temperatures. To determine this question it was essential to use a temperature many degrees higher than that ever reached by the atmosphere. For this purpose 4 decigrms. of pure glucina were dissolved in the usual way in 100 c.c. of solution of carbonate of ammonium. 15 c.c. of this solution were transferred to a glass tube, which was then sealed and heated to 100° for two days. *The solution remained perfectly clear.*

2. *Does Glucina Confer its Solublility on Alumina, or does Alumina Confer its Insolubility on Glucina?*

The following experiment was made to affix a quantitative value to the amount of alumina soluble in carbonate of ammonium when no glucina was present to influence its solubility.

0·5000 grm. of pure alumina was dissolved in hydrochloric acid and precipitated (after neutralisation with carbonate of ammonium) with 100 c.c. of solution of the carbonate. The whole was thrown on a filter at once. The contents of the filter were washed, dried, and ignited. The alumina which had precipitated at once weighed 0·4702 grm. The filtrate, on standing twenty-four hours, had yielded a deposit weighing 0·0281 grm. These numbers, reduced to percentages, are as follows:—

Alumina precipitated at once	94·04
,, coming down afterwards ..	5·62
Loss	0·34
	100·00

It was considered that the question, whether glucina confers its solubility on alumina, would be best answered by treating with carbonate of ammonium a mixture containing a great excess of glucina.

Experiment I.—A mixture was therefore made of 0·2500 grm. of glucina and 0·0250 grm. of alumina. It was dissolved in hydrochloric acid, and the excess of acid was removed by evaporation; 50 c.c. of carbonate of ammonium solution were then added. The precipitate at first formed *entirely re-dissolved* in a few minutes, but the alumina commenced to deposit it about fifteen minutes afterwards. The mixture was allowed to stand for twenty-four hours and was then filtered. The precipitate of alumina containing glucina weighed 0·0323 grm. The glucina recovered from the solution weighed 0·2407 grm.; or, per cent:—

	Composition of Mixture.	Found after One Extraction.
Glucina	90·91	87·53
Alumina	9·09	11·75
	100·00	99·28

The glucina, although in such great excess, had, therefore, under the circumstances indicated, not conferred its solubility on the alumina; but, on the contrary, the alumina had conferred its insolubility on the glucina.

Experiment II.—The alumina obtained in the manner described was re-dissolved, re-precipitated, and again treated with 25 c.c. of carbonate of ammonium solution for twenty-four hours. The glucina had now increased to 0·2432, and the alumina diminished to 0·0298. The composition of the mixture, as found after two extractions, was therefore as follows:—

	Found after Two Extractions.
Glucina	88·44
Alumina	10·84
	99·28

* *American Journ. of Science*, xxxvi., p. 89.

† The solution of carbonate of ammonium used in these experiments was always of the same strength, *i.e.*, a cold saturated solution, sp. gr. 1·080.

After two extractions the alumina therefore still retained nearly 2 per cent of glucina.

Experiment III.—Although these results seemed conclusive as far as they went, the author resolved to repeat the experiment with a mixture containing a still greater excess of glucina, because it appeared especially important in an inquiry of this kind to know the behaviour towards a solution of carbonate of ammonium, of glucina containing a comparatively small proportion of alumina. For this purpose a mixture was taken of 1 grm. of glucina and 3 centigrms. of alumina; it was dissolved as usual, precipitated in the form of carbonates of the earths, and heated with 100 c.c. of solution of carbonate of ammonium. The earths dissolved entirely at first; but small as the quantity of alumina was, the solution began to get turbid in about ten minutes. The mixture was left in the cold for twenty hours. The residue of alumina containing glucina was then filtered off, treated in the usual manner, and weighed. The glucina recovered from the solution weighed 0·9846 grm.

	Composition of Mixture.	Found after One Extraction.
Glucina	97·09	95·59
Alumina	2·91	4·16
	100·00	99·75

Alumina, therefore, even when mixed with glucina to the small extent of 3 per cent, renders some of the latter insoluble; this, then, is a distinct answer to the question at the head of the section.

3. *With what Amount of Accuracy can a Mixture of Glucina and Alumina be Separated by Means of Carbonate of Ammonium?*

The fact that alumina confers its insolubility on glucina is the cause of the difficulties that have been found in the separation of the two earths. The author's experiments showed that one treatment with carbonate of ammonium is insufficient to dissolve the glucina out from such a mixture. He wishes, however, to guard himself from appearing to express the opinion that it would be impossible, by a modification of the process, to effect the separation at one operation, as he is now engaged in an attempt to solve that problem.

In order to ascertain the number of times that it would be necessary to treat the insoluble residue with carbonate of ammonium, in order to extract all the glucina, the following experiments were made:—

Experiment I.—A mixture was taken of 0·5000 grm. of glucina and the same amount of alumina; after three treatments for forty-eight hours each with carbonate of ammonium the following results were obtained. The residue of alumina weighed 0·5107 grm.

No. of Extractions.	Glucina Obtained.
I.	0·3896
II.	0·0739
III.	0·0203
	0·4838

	Composition of Mixture.	Obtained in Three Treatments.
Glucina	50·00	48·38
Alumina	50·00	51·07
	100·00	99·45

Experiment II.—Upon a similar mixture the following modification of the process was tried. The mixture was dissolved in hydrochloric acid, the excess of acid was neutralised with ammonia, and 200 c.c. of a *warm* solution of ammonium carbonate were added. The solution was stirred briskly for five minutes, and then filtered off rapidly. The precipitate was only washed moderately so as not to dilute the filtrate too much. The filtrate was allowed to stand for twenty-four hours, the deposit was filtered off, added to the first residue, dissolved with it in hydrochloric acid, and again treated twice with 100 c.c. of carbonate of ammonium solution in the cold for twenty-four hours each time. The alumina weighed 0·5201 grm.

No. of Extractions.	Glucina Obtained.
I.	0·4450
II.	0·0163
III.	0·0161
	0·4774

	Composition of Mixture.	Obtained in Three Treatments.
Glucina	50·00	47·74
Alumina	50·00	52·01
	100·00	99·75

Experiment III.—A mixture was then prepared of 0·2640 grm. of glucina and 0·8520 grm. of alumina. It was dissolved in hydrochloric acid, neutralised with carbonate of ammonium, and digested with 95 c.c. of the carbonate of ammonium solution for twenty-four hours; it was stirred occasionally. The solution was then filtered, the residue dissolved in hydrochloric acid, and after neutralising was heated with 100 c.c. of a cold solution of carbonate of ammonium, and allowed to stand twelve hours. The glucina was separated in the usual manner. This mode of proceeding was repeated seven times with the results given in the annexed Table:—

No. of Extractions.	Glucina Obtained. Per cent.
I.	12·75
II.	3·24
III.	0·61
IV.	3·74
V.	1·26
VI.	0·56
VII.	1·13
	23·29

	Composition of Mixture.	Obtained in Seven Treatments.
Glucina	23·66	23·29
Alumina	76·34	—
	100·00	

The alumina was not estimated in this experiment.

The answer, then, to the question at the head of the section is, that results to within half a per cent of the truth can be obtained by means of the carbonate of ammonium process if a sufficient number of extractions be made.

4. *How do Solutions of Glucina and Alumina Behave with Carbonate of Barium?*

To study this subject quantitatively the author made the following experiments:—

Experiment I. (*Precipitation of Alumina in the Cold by Carbonate of Barium.*)—0·8034 grm. of pure alumina was dissolved in hydrochloric acid. The solution was nearly neutralised with carbonate of sodium, and an excess of carbonate of barium, made into a cream with water, was added. After standing twelve hours the precipitate was collected, washed, and dissolved in hydrochloric acid. The solution was then boiled and precipitated with an excess of sulphuric acid. The sulphate of barium was filtered off with the usual precautions, and the filtrate was precipitated by ammonia. The precipitate was thoroughly washed, dried, and ignited; it weighed 0·8005 grm., or 99·64 per cent on the original alumina. Alumina is therefore completely precipitated in the cold by carbonate of barium.

Experiment II. (*Precipitation of Glucina in the Cold by Carbonate of Barium.*)—0·5175 grm. of pure glucina was

dissolved in hydrochoric acid, and treated precisely as the alumina had been in the last experiment. The precipitate weighed 0·1070 grm., or 20·68 per cent on the original glucina. This result, therefore, confirms the observation of Awdejew,* that glucina is only imperfectly precipitated by carbonate of barium in the cold, and, under the circumstances indicated, behaves like the nitrate in Ordway's experiment.†

Experiment III. (*Precipitation of a Mixture of Glucina and Alumina in the Cold by Carbonate of Barium.*)—0·2096 grm. of pure alumina and 0·2055 of pure glucina were dissolved in hydrochloric acid, and treated precisely like the alumina in Experiment I. The precipitate of the mixed earths weighed 0·3874 grm., or 93·33 per cent on the original weight. Alumina, therefore, in this case, as in the experiment with carbonate of ammonium, communicates much of its insolubility to the glucina.

Assuming only the portion precipitated by carbonate of barium to be accounted for in the analysis of a beryl containing 28·89 per cent of the mixed earths, only 26·96 would be obtained, the loss being 6·67 per cent, which, as we have seen, would fall chiefly upon the glucina, if the operation were conducted in the cold. This loss is, however, variable, and appears to depend, to some extent, upon the relative proportions of the two earths.

ON THE DETERMINATION OF COPPER IN "ORE REDUCER" SLAG.

By T. C. CLOUD.
Assoc. Royal School of Mines.

THE following experiments were undertaken with the view of ascertaining whether the method of decomposing "ore reducer" slag by means of nitro-hydrochloric acid, as usually recommended, is one of general application, and suitable for the determination of copper in the slags produced at these Works.

A sample of "ore reducer" slag was ground down, in an agate mortar, to an impalpable powder—finer, indeed, than is usual in connection with this method. Two grms. were digested with nitro-hydrochloric acid for three days (twenty-four hours) in a covered beaker. At the end of this time the cover was removed, and, after washing it and the sides of the beaker with water, sulphuric acid was added, and the contents of the beaker evaporated until the fumes of this acid commenced to be evolved. When cool, water was added, and the copper determined by plating it out on a weighed platinum cylinder forming the cathode of a two-cell Daniell's battery. When all the copper had been thus deposited from the solution the platinum cylinder was removed, washed successively with boiling water and alcohol, dried at 100° C., and re-weighed. The sample of slag in question, treated as described, gave 0·25 per cent copper. Another portion of the same sample, treated as above described, but with the addition of a small quantity of concentrated sulphuric acid previous to the nitro-hydrochloric acid, gave 0·35 per cent copper. It was evident, from the appearance of the contents of the beaker, that decomposition had proceeded farther than in the first instance, but a large quantity of dark-coloured silicate yet remained. After the copper had been removed from the solution the insoluble residue was dried, and again treated with acid as before for three days. The solution again yielded copper.

The endeavour was next made to decompose the slag by fusion with bisulphate of potash. Two grms. of the slag were fused with a considerable excess of the salt for one hour, and the fused mass, after cooling, treated with water. A dark-coloured residue, apparently of undecomposed silicate, remained. The sample thus treated gave 0·59 per cent of copper.

Finally, the thorough decomposition of the slag was effected by fusing it with 4 parts of the mixed carbonates of potash and soda and one-fourth part of nitrate of potash. The fused mass was treated with dilute sulphuric acid evaporated to a suitable quantity, and the copper determined as above described. The total amount of copper in the slag was thus shown to be 0·64 per cent.

A sample from another slag gave, by treatment with the three acids, 0·55 per cent of copper; by fusion with alkaline carbonates and small quantity of nitrate of potash it gave 0·60 per cent. In no case, so far as my experience goes, is the slag completely decomposed by treatment with acids, even when the action is continued for three days; but it frequently happens that the copper is *nearly* all in that portion which is decomposed, as is instanced in the result obtained from the second sample mentioned above. More frequently, however, the copper is not all obtained in solution. From these results it is evident that the most reliable method for general use is by fusion in the usual manner. With the slag decomposed in this way, and the copper determined in the manner indicated,* the process leaves nothing to be desired, either on the score of accuracy or speed.

Laboratory, "Wallaroo Smelting Works,"
Wallaroo, S. Australia, March 10, 1877.

* *Poggendorff's Annalen*, lvi., p. 101.
† *Silliman's American Journ.*, xxxi., p. 197.

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.†

Section I.

THE DETERMINATION OF POTASSIUM IN COMMERCIAL POTASH SALTS.

THE evidence on this subject obtained previously to the last Meeting (Bristol) of the Association, showed that the method of determining potassium by precipitation, as a platinum salt, was almost universally employed by chemists of large experience in the assay of potash salts. The Committee thought it desirable, therefore, to subject the process to an exhaustive examination, with a view of ascertaining the origin of the discrepancies known to occur between the results of chemists using different modifications of the general method of estimation by platinum.

The process of determining potassium by platinic chloride is well known to depend on the sparing solubility of chloro-platinate of potassium and the easy solubility of the chloro-platinates of the associated metals. The precipitate is crystalline, of a bright yellow colour, and is easily dried. On account of its solubility in aqueous liquids, it is necessary to operate on concentrated solutions and to employ alcohol for washing. When the precipitate is produced suddenly, by addition of platinic chloride to a concentrated solution of potassium chloride, or by rapidly cooling a hot saturated aqueous solution of potassium chloro-platinate, it is obtained in a finely granular or pulverulent form, which presents some difficulty in manipulation, from its tendency to creep over the edge of the filter. When the chloro-platinate is formed by the gradual concentration of a dilute aqueous solution, or by adding chloride of platinum to a dilute solution of chloride of potassium, and then concentrating,

* The usual colouration test might possibly be employed here if an approximate result is all that is required, but I have not tried it in connection with the fusion process.

† Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

the precipitate assumes the form of dense crystalline scales, the subsequent manipulation of which is very easy.

The following modifications of the general process have been employed by the Committee with the view of testing their comparative accuracy under various conditions likely to occur in practice. The information forming the basis of the experiments was chiefly communicated to the Committee during last year, and to a great extent was incorporated in the Report presented at the Bristol Meeting.

Modification I.—Essentially the process of Professor Fresenius described in his "Manual of Quantitative Analysis," being shortly as follows:—The solution of mixed chlorides of potassium and sodium, freed, if necessary, from calcium, magnesium, and sulphates, was evaporated nearly to dryness with excess of solution of platinic chloride. (In many of the experiments a considerable excess of platinum was employed beyond the quantity required to convert both the alkali metals into chloro-platinates.) The evaporated solution was then treated with alcohol of about 80 per cent, transferred to a small filter, washed with alcohol of 80 per cent, and carefully dried. The bulk of the precipitate was then transferred to a weighed capsule, dried at 100° C., and weighed. The filter with from 1 to 3 milligrammes of adherent precipitate was ignited, the weight of the filter-ash (0·0004 grm.) subtracted, and the residue of $Pt+2KCl$ calculated to $2KCl+PtCl_4$, the amount thus obtained being added to the main quantity.

Modification II.—The above process, with the following precautions, was recommended by Dr. Fresenius in a communication to this Committee:—"To make sure not to keep any chloride of sodium along with the chloride of platinum and potassium, I first extract the chloride of platinum and sodium with spirits of wine of 80°, and then wash the chloride of platinum and potassium with a few c.c. of water, drop by drop; then I evaporate this solution, adding a little chloride of platinum, treat the small precipitate again with spirit of wine, and add the small quantity of chloride of platinum and potassium to the bulk."

Modification III.—The third modification is that of Drs. Frank and Berrand, of Leopoldshall. These chemists employ only about 0·2 grm. of the potassium salt, and manipulate like Fresenius, but they wash the precipitate with alcohol of 98 per cent, which is practically absolute. They dry the precipitate at 110° C.

Modification IV.—The fourth modification is that of Mr. R. R. Tatlock, who thus describes it in his communication to the Committee:—"A portion of the solution, equal to 10 grains of the original sample, is delivered into a small basin, diluted with 400 grains or so of water, and acidified slightly with hydrochloric acid. About 500 grs. of platinic chloride solution (containing at least 25 grs. of platinum) are added, and the fluid evaporated nearly to dryness on a water-bath. A few drops of water are then added to the residue, and the evaporation repeated to expel the excess of hydrochloric acid. About 50 grs. more of the strong platinic solution are mixed with the precipitate, and the whole stirred well and set aside in a cold place for at least an hour, with occasional stirring. The precipitate is then thrown on a very small filter (unweighed), the basin rinsed out with about 10 drops more of the platinum solution, and the precipitate on the filter washed with 10 or 15 drops more. The basin and the filter and contents are then washed with the smallest possible quantity of alcohol of 95 per cent strength, and dried at 100° C. The dried precipitate is transferred as completely as possible to a small capsule, in which it is further dried until it assumes a distinct orange colour, and weighed. The filter, with a trace of adhering precipitate, is ignited on a crucible lid, and the residual metal, with its corresponding chloride of potassium, calculated to potassio-platinic chloride, and the weight added to that of the precipitate."

From the above description it will be seen that the chief points of difference in the processes are as follow:—

Fresenius (Process I.) uses moderately strong alcohol (80 per cent for washing the precipitate, but in his modified process he subsequently uses a few centimetres of water, and recovers any potassium salt thus dissolved.

Frank and Berrand wash with absolute alcohol.

Tatlock washes first with strong solution of platinic chloride, and then with strong alcohol.

In all editions of his "Quantitative Analysis" prior to the 7th English, Fresenius directs the drying of the precipitated chloro-platinate at 100° C. In the last edition drying at 130° C. is recommended. Frank and Berrand use 110° C. Until after the conclusion of the investigations the words "further dried," in Tatlock's method, were understood by the Committee to signify longer drying at 100° C., but it has since been learnt that drying at a somewhat higher temperature was intended.

In all cases in which the temperature used for drying the precipitate is not expressly stated, the Committee employed 100° C. The experiments instituted to ascertain the influence the temperature used in drying had on the weight of the precipitate showed a loss of 0·067 per cent, by subjecting the precipitate thoroughly dried at 100° C. to a temperature of 140° C. for one hour. This loss represents only 0·02 for 100 parts of potassium chloride.

In order to obtain a satisfactory basis of investigation it was necessary, in the first place, to obtain perfectly pure potassium salts, and as a necessary condition of the requisite purity was complete freedom from sodium compounds, their preparation was found less easy than might be expected.*

In the first place an attempt was made to obtain pure potassium chloride by repeatedly evaporating pure nitre with hydrochloric acid. The result showed that the reaction took place with far less facility than was expected, and the process was abandoned.

Chloride of potassium was next obtained by dissolving the purest commercial acid potassium carbonate in hydrochloric acid, filtering and repeatedly crystallising the product. Ignition of the crystals on platinum wire in the Bunsen flame showed the presence of sodium in abundance, and two determination of the real chloride of potassium as platinum salt gave 98·93 and 98·85 per cent respectively. A highly satisfactory product was at length obtained by the following process:—Cream of tartar was dissolved in hot water, the liquid filtered, and the acid-tartrate of potassium obtained by cooling the solution. The product was re-crystallised, and then tested for sulphates and sodium, neither of which was found. The dried crystals were ignited, the mass dissolved in water, the liquid filtered, nearly neutralised with hydrochloric acid, a few drops of oxalate of ammonium added, again filtered, and the solution evaporated to dryness. The resultant chloride of potassium reduced to powder. The product was absolutely free from sulphates, completely soluble in water, and the solution was perfectly neutral. The salt showed no trace of sodium when heated on platinum wire in the Bunsen flame.

The hydrochloric acid used in the experiments was prepared by acting on common salt by non-arsenical sulphuric acid, and passing the washed gas into distilled water.†

The platinic chloride was obtained by reducing the commercial chloride (which contains iron and other impurities) by boiling with caustic soda and alcohol, thoroughly washing (first by decantation and afterwards on the filter) the resulting platinum black, boiling it for some time with hydrochloric acid, and again thoroughly wash-

* A shorter method than those tried would probably have been to ignite pure potassium chlorate.—A.H.A.

† For some years all the hydrochloric acid employed in my laboratory has been prepared by this process. It is more convenient, and furnishes a far superior product to that obtained by distilling the impure liquid acid.—A.H.A.

ng with hot water, and igniting in a muffle. The metallic platinum was boiled with nitric acid, re-washed and re-ignited, and then weighed and dissolved in aqua regia. The platinic chloride solution thus obtained was evaporated nearly to dryness, first with hydrochloric acid, and then several times with water, in order to get rid of the free acid as much as possible.* Ultimately the solution was diluted, filtered from any insoluble residue (which was ignited and weighed, and the weight deducted from the original), and the filtrate further diluted until 100 c.c. contained about 6 grms. of metallic platinum.

As the projected researches required that the weight of potassium salt used in each experiment should be known with the greatest possible accuracy, it was considered desirable to avoid direct weighing of the solid salt by employing a definite amount of solution of known strength. For this purpose the capacity of a pipette, which nominally held 10 c.c., was accurately ascertained. The pipette was filled to the mark with distilled water at a temperature of 20° to 21° C. The contents were then allowed to flow into a small accurately tared beaker. The pipette was then allowed to drain for exactly thirty seconds, when the last drop of fluid was expelled by gentle blowing, the nose of the pipette being held in contact with the beaker so as to avoid any chance of loss. This plan was found to result in the delivery of a more constant weight of fluid than spontaneous draining, with or without subsequent contact of the point of the pipette with the main volume of the liquid. The same pipette was always employed, and the contents were delivered in the same manner. All the measurements were made at pretty nearly the same temperature.

As a result it was found that in a series of nearly twenty experiments, the extreme variation in the weight of distilled water delivered was 8 milligrms., or about 0·08 per cent of the weight, while the great majority of the determinations were within 2 milligrms. of the mean. The result of using the pipette for measuring out 10 c.c. of a 10 per cent solution of chloride of potassium would be that the maximum deviation from the mean would be 0·04 per cent of the weight, though the maximum difference in two successive measurements might amount to twice this amount. The experiments showed that at 20° C. the pipette delivered a mean weight of 9·9329 grms. of distilled water. The most convenient quantity of chloride of potassium for precipitation with platinic chloride is about 0·7 grms. or 10 grains. A solution of pure chloride of potassium was therefore prepared of such strength that the pipette should deliver about that amount. The exact amount of chloride of potassium contained in one pipette delivery of the solution was next ascertained. Two determinations were made by precipitating a pipetteful with nitrate of silver, and one by direct evaporation of the liquid to dryness, with subsequent cautious heating of the residue—

A1. AgCl = KCl 0·6968 grm.
A2. AgCl = KCl 0·6971 ,,
B1. By evaporation = KCl 0·6970 ,,

The mean of these closely concordant result is 0·69697 grm.; 0·697 grm. was therefore considered as the true amount of chloride of potassium in the solution delivered by the pipette.

At a somewhat advanced period of the investigations some irregularities in the results led to a doubt as to the degree of accuracy attainable by pipette measurements, and it was decided to commence an entireiy new series of experiments on a different basis. Recognising the advantage the employment of solutions has over direct weighing of the solid salt, it was decided to *weigh* each quantity of solution employed, merely trusting to measurement to obtain approximately the same quantity. By proceeding in this manner all errors due to unequal deliveries of the pipette or accidental alterations of temperature were entirely eliminated.

For these experiments a fresh solution of chloride of potassium was prepared, by dissolving a known weight of the pure potassium chloride in exactly ten times its weight of distilled water.*

In the experiments made on the weighed, solution the required quantity was approximately measured by running it from a burette into an accurately tared beaker, and the *exact* quantity taken was then ascertained by weighing. In this manner the amount of potassium salt employed in each experiment was ascertained with great accuracy. The error in the amount taken could not be more than 0·00005 of a gramme, or about 0·007 per cent of the quantity used.

With the new solution the following experiments were made as a check on its strength :—

By precipitation with nitrate of silver :—

	Weight of Solution	= KCl.	Weight of AgCl	= KCl	= Per cent.
A 1.	7·7065	0·70060	1·3459	= 0·70017	= 99·94
A 2.	7·7455	0·70414	1·3534	= 0·70408	= 99·99

By direct evaporation :—

	Weight of Solution	= KCl.	Residue	= KCl per cent.
B 1.	7·7110	= 0·7010	0·7005	= 99·93

In this case half a milligramme loss of chloride of potassium, probably due to decrepitation on heating the residue, caused a difference of 0·07 per cent.

In the foregoing and all subsequent experiments the following atomic weights and factors were employed :—

Chlorine	35·475	Stas, 1865.
Potassium	39·137	,, ,,
Silver	107·930	,, ,,

$$AgCl \times 0{\cdot}52023 = KCl.$$

The atomic weight of platinum was calculated from the original data of Berzelius obtained by the analysis of potassium chloro-platinate, but substituting Stas' numbers for chlorine and potassium for those employed by Berzelius. This gives the result—

$$Pt'''' = 197{\cdot}1937.$$

Hence—

$$K_2PtCl_6 \times 0{\cdot}16033 = K_2$$
$$K_2PtCl_6 \times 0{\cdot}19310 = K_2O$$
$$K_2PtCl_6 \times 0{\cdot}30560 = 2KCl.$$

Fresenius, in the last edition of his "Quantitative Analysis" (7th English) adopts the number 98·59 as the atomic weight of di-valent platinum, which also gives the factor 0·3056 for calculating the chloro-platinate into chloride of potassium. In former editions Andrews's number of 98·94 was adopted for platinum, which caused a sensible difference in the percentage of potassium chloride obtained. The factor 0·30507, resulting from the employment of Andrews's atomic weight for platinum, is adopted by Drs. Frank and Berrand in their communication to this Committee. The consequence of employing the above factors in calculating the percentage of chloride of potassium corresponding to the precipitate of chloro-platinate obtained is shown in the following statement .—

	Precipitate	× Factor	= KCl per cent'
Committee	3·2723	× 0·30560*	= 100·00
Fresenius	3·2723	× 0·30560	= 100·00
Frank and Berrand	3·2723	× 0·30507	= 99·83

* This method of prepariug pure chloride of platinum is practically identical with that recommended by Messrs. Chalmers and Tatlock, in a paper read before the Chemical Section of the Philosophical Society of Glasgow, April 20th, 1868. The Committee has adopted the same process for recovering the platinum from the precipitates and filtrates obtained in the experiments.

* It is obvious that the subsequent calculations would have been facilitated by dissolving the salt in *nine* times its weight of water instead of *ten*. This consideration did not present itself till it was too late to take advantage of it.

* This factor was adopted by Messrs. Chalmers and Tatlock as long ago as 1868.

The committee is informed that the factor 0·194 is adopted by some chemists for calculating the chloroplatinate to anhydrous potash, a plan which would cause the result of 100·52 of chloride of potassium to be obtained instead of 100·00.

(To be continued.)

THE JABLOCHKOFF ELECTRIC CANDLE.

A SECOND series of experiments illustrating the lighting capabilities of this important invention took place on Friday evening last, at the West India Docks, in the presence of a large body of scientific gentlemen and others interested in this last addition to our illuminating appliances. On this occasion everything worked smoothly, and taking the experiments as a whole they were eminently satisfactory. The electric power was produced by one of the Paris *Alliance* Company's magneto-electric machines, with thirty-two horse-shoe magnets of seven plates each, and worked by a small agricultural engine of about eight horse-power.

The trials commenced at 9 o'clock with the lighting-up of the yard, which was described in our article (CHEM. NEWS, vol. xxxv., p. 238). Four lamps, mounted on posts about 15 feet high, were used, each of which were said to be equal to one hundred gas-lights, but the size of the gas-light was not specified. The lights were toned down by opal glass globes, which seemed somewhat too thick for the purpose, the light given out by the candles being, if anything, a little too subdued. The very slight flickering, of which we have already spoken, was much less apparent than on the occasion of the first trial—an improvement which was no doubt due to the engine being in better working order. It seems that a great deal depends on the motive power working regularly; for after the lamps had been burning for about five minutes the light suddenly improved, becoming much more steady and brilliant. After burning for about twenty minutes the lights were extinguished, and four gas-lamps, with four powerful burners to each, were turned on, evidently with the intention of showing the difference between the orange colour of the gas-flame and the pure white of the electric lamp. The company then adjourned to a large warehouse at the top of an adjacent building, measuring about 50 yards long by 25 yards wide, which was lighted from the outside by three electric candles without any intervening globes. Two of these candles were placed at the side and one at the end, but being only breast high the shadows of persons passing in front of them greatly interfered with the experiments tried. One of the objects of this portion of the trial was to ascertain whether this light could be used for sampling various descriptions of produce and merchandise. Several experts were present, but owing to the position of the light being horizontal instead of vertical there seemed to be some doubt as to its value in the case of samples of coffee, grain, pepper, and similar commodities, inasmuch as the strong shadow cast horizontally by the individual grains of the produce under examination interfered materially with their colour —the particular tint of a coffee berry, for instance, being an important factor in the estimation of the value of a sample. It was far otherwise with a number of samples of coloured alpaca goods. The most difficult colours to judge of by gas-light, or during foggy weather, are dark olive greens, puces, and blues. Next to these come the lightest shades of straw-yellow and cream-colour. In the first case the colours are not to be distinguished from black, and in the second from white; but under the electric light the darkest Navy blues and the lightest greys came out in their true tints, even to the eyes of the uninitiated. The company then adjourned to the quay below, alongside which a large barque had been moored. Here the practicability of lighting ships' decks and holds, and the adjoining wharfs, was most satisfactorily demonstrated, as well as the portability of the light itself.

The amount of heat given off by M. Jablochkoff's candle is comparatively small, the glass globe of one of the lanterns used for lighting up the ship having been found to be only just comfortably warm after having been lighted for twenty minutes.

The last experiment tried was, scientifically speaking, the most interesting of the whole, demonstrating as it did that M. Jablochkoff has succeeded in entirely doing away with the necessity for using carbons for the electric light. His newest form of candle consists of a thin plate of his kaolin composition, about 1½ inches long by 1 inch broad, and about $\frac{1}{10}$th inch thick. The sides of the plate are inserted in grooves cut in the wires forming the electrodes of the battery, which project very slightly above the top of the plate. In order to light this new form of candle a bridge of ordinary graphite is carried along the top edge of the porcelain plate. The graphite becomes incandescent, causing the porcelain to melt, which then becomes a conductor. The graphite gradually disappears, and the melted portion of the porcelain becomes incandescent, gradually vapourising at the rate of a millimetre an hour. The light given out by the porcelain seems softer, mellower, and much more constant and steady, than that given off by the combination of carbon and porcelain: indeed after five minutes' examination with black spectacles we failed to discern anything more than a barely perceptible start at distant intervals.

Altogether MM. Jablochkoff and Denayrouze may be congratulated on the success which attended their very interesting series of trials on Friday night.

PROCEEDINGS OF SOCIETIES.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

June 11th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

DR. R. BIEDERMANN presented a communication on the "*Action of Phthalic Anhydride on Diamines.*" By melting the two substances together tolylene-diamine and phthalic anhydride yield $C_7H_6[N(CO)_2C_6H_4]_2$, melting at 104°, and $C_7H_6(NH)_2(CO)_2C_6H_4$, melting at 192°. These two phthalyl-tolylene-diamines result in all cases also when various dehydrating agents are used. The solubility of the first in alcohol, and of the other in acetic acid, permits an easy separation. Alkalies decompose the compounds into tolylene-diamine and phthalates. Perfectly analogous bodies are yielded also by the diamidobenzenes.

Dr. A. PINNER has found a "*Hexyl Chloral*, $C_6H_9Cl_3O$," among the by-products yielded in the preparation of croton chloral, boiling at 212°, and uniting neither with water nor CNH. It possesses no special action on the animal organism. Nitric acid changes it into trichlorocaproic acid, $C_6H_9Cl_3O_2$, insoluble in water, and reducible by zinc to a hexylenic acid, $C_6H_{10}O_2$, isomeric, if not identical, with the ethyl-crotonic acid of Frankland and Duppa. Allylene tetrachloride was found to be present in considerable quantities in crude croton chloral.

Dr. A. PINNER and Fr. FUCHS, "*Derivatives of Chloral.*" Chloral-acetyl-cyanide, $CCl_3.CH(OC_2H_3O).CN$, was obtained by the action of acetic anhydride on chloral-cyanhydrate. This compound yields with H_2SO_4, acetyltrichloro-lactamide; with aniline, dichloro-acetanilide; with acetate of aniline, mono-chlor-acetanilide; with NH_3, dichlor-acetamide; and with ammonium acetate, dichlor-

acetic ether. Chloral-cyan-hydrate itself gave with H_2SO_4 trichloro-lactamide; with acetate of aniline, trichlor-ethyliden, diphenyl-diamine; and with urea, dichlor-acetyl-guanidine. Ammonium acetate and chloral hydrate yield trichlor-ethylidene-imide, $CCl_3.CHNH$, the first imide of the composition, X.CHNH as yet prepared.

The following communications have been received from non-resident members:—

E. LINNEMANN, "*On Propylene.*" The author shows the inability of propylene to unite with H_2O at 100° and form propyl alcohol.

"*Acrylic Acid.*" It is found that by melting sodium acrylate with alkalies hydrochloric acid and lactic acid are produced, the former yielding by decomposition acetic acid and formic acid.

A. BAEYER describes at length "*Oxy-phthalic Acid*, $C_8H_6O_5$." It is obtained in the form of the ether by the action of $NaNO_2$ on the ether of amido-phthalic acid. The acid itself crystallises in colourless rosettes, melts at 180°, is easily soluble in boiling water and ordinary solvents, forms easily soluble salts, and changes into the anhydride on fusion. It resembles phthalic acid in general, and forms oxyphthaleins with phenol, resorcin, &c., closely allied to the phthaleins. The position of the HO group has not been determined.

C. BÖTTINGER, "*On Glyoxylic Acid.*" This acid yields on treatment with HCN glycollic acid and CO_2; and by means of Perkin's reaction with acetic anhydride and sodium acetate, oxalic and glycollic acids.

R. FRUHLING and J. SCHULZ describe a "*New Method of Preparing Betain*, $C_5H_{11}NO_2$, from the mother-liquor obtained in Scheibler's treatment of molasses. By the addition of a mixture of H_2SO_4 and alcohol, lime and potash are precipitated, while betain and the organic acids are dissolved in the alcohol. The separation of the betain from this solution is performed by means of a stream of HCl gas, and depends on the insolubility of the hydrochlorate in alcohol containing HCl. Pure betain is obtained by the action of Ag_2O on the aqueous solution of the hydrochlorate.

G. LUNGE, "*Estimation of Nitrous and Nitric Acids.*" A series of comparative experiments tend to show that HNO_3 is determined more accurately by the method of oxidation with iron, and titration of the unoxidised residue with a solution of potassic permanganate, than by Siewert's method (reduction in alkaline solution with Zn and Fe). Titration with potassic permanganate is regarded as the only reliable process for determining nitrous acid. Hart's method with urea, with Crowder's modifications, as well as other methods, all failed to give as accurate results when tried on a solution of pure $AgNO_2$ in concentrated H_2SO_4. The determination of the two acids in the same solution is performed by first titrating the nitrous acid with permanganate, and then proceeding as above for the nitric acid.

H. PANISCH has prepared "*Para-tolyl-phenyl-acetic Acid*, $(C_6H_5)(CH_3C_6H_4)CH.CO_2H$," by the action of toluen and zinc on phenyl-bromo-acetic acid, accompanied by small quantities of the ortho acid. Oxidation changes it into tolyl-phenyl-ketone, and para-benzoyl-benzoic acid.

T. ZINCKE, "*Chlorides of Hydro-benzoin and Iso-hydro-benzoin.*" These two alcohols yield with PCl_5 and PCl_3 identical chlorides, $C_{14}H_{12}Cl_2$, hydro-benzoin, forming also a second isomer. All of these chlorides yield on regeneration of the alcohols iso-hydro-benzoin accompanied by but microscopic quantities of hydro-benzoin.

C. WACHENDORFF and T. ZINCKE obtain "*Styrolen Alcohol* (*Phenyl-glycoll*), $C_6H_5.CHOH.CH_2OH$," by treating styrolen bromide with $AgNO_3$ or $C_2H_3O_2K$, and saponifying the ether formed. No isomer was observed. The alcohol crystallises in needles, and is easily soluble in water. Several ethers have been prepared.

O. JACOBSEN, "*Extraction of Xylens from Tar.*" By warming that portion of the crude xylols obtained from tar (which does not dissolve in ordinary sulphuric acid) with fuming acid, para-xylol is separated out in the form of the sulphonic acid, from which heating at 195° with HCl releases the hydrocarbon. The portion dissolved in ordinary sulpburic acid contains the meta- and ortho-xylens. On addition of $NaCO_3$ the sodium salt of ortho-xylen sulphonic acid crystallises out, and leaves the meta-salt in the mother liquor.

J. THOMSEN, "*Heat of Solution of* Cl, Br, *and* I *Compounds.*" The author gives the tabular results of his experiments on eighty-six different bodies. The anhydrous compounds dissolve in water partially with absorption, and partially with development of heat. Tl_2Cl_2 and Al_2Cl_6 represent the two extremes. Those compounds dissolving with development of heat form crystalline compounds with water. The hydrous salts show, with but few exceptions, an absorption of heat on solution. The heat of solution of the anhydrous salts increases with the atomic weight of the electro-negative components, and with the decreasing atomic weight of the electro-positive components, *i.e.*, is greater for I than Cl, for Mg than Ba. The same author shows that uniform laws hold good for the formation of ethers, and for the partial decomposition of salts in aqueous solutions by acids.

L. BRIEGER detects among the "*Volatile Constituents of Human Excrement*" acetic acid, butyric and isobutyric acids, phenol, indol, and a new substance—Skatol—allied to indol, and forming the chief portion of the aromatic fraction. Skatol is a white crystalline body, not so soluble as indol, and when injected beneath the skin enters as a colouring matter into the urine.

M. NENCKI, "*On the Processes of Decay.*" By the distillation of old Roquefort cheese with sulphuric acid a volatile oil is obtained, to which the cheese owes its peculiar odour and taste. It is yellow, reacts neutral, and possesses a sharp burning taste.

L. LIEBERMANN, "*On Nitro-benzoic Acids.*" In response to the late paper of Fittica on this subject (CHEMICAL NEWS, vol. xxxv., p. 142), the author states that he has obtained an acid corresponding to Fittica's fourth isomeric nitro-benzoic acid, melting at 127°, by preparing the Ba salt of the nitration products of benzoic acid, decomposing with HCl the first portion of the salt which crystallises out, changing this acid into a Ba salt, and repeating the process several times. After obtaining the acid melting at 127° the process was continued, and it was found to consists of a mixture of the three known nitro-benzoic acids. Further experiments were made on the melting-points of mixtures of acids, which showed that they are always lower than that of the lowest melting acid in the mixture, if equivalent quantities are taken, and under all circumstances lower than the highest.

L. B. HALL and I. REMSEN obtain a "*Para-sulphamic-mesitylic Acid*, $C_6H_2.(CH_3(2.COOH.SO_2NH_2$," by the oxidation of mesitylen-sulphamide. The groups SO_3H and COOH are regarded as in the ortho position, on account of the impossibility of obtaining anortho-sulpho-benzoic acid from the ortho-toluolen sulphonic acid.

M. W. ILES and I. REMSEN have examined the "*Oxidation Products of the Sulphonic Acids of Meta-xylol.*" Xylol-sulphamide melting at 110° yielded a sulphamine-meta-toluic acid, $C_6H_3.SO_2NH_2.CH_3.COOH$, regarded as possessing the position 1, 2, 4. The amide melting at 132° is decomposed entirely by oxidation.

E. HART and I. REMSEN have obtained "*Two Isomeric Sulphonic Acids from Para-nitro-toluen*" by the action of fuming H_2SO_4, instead of the single one described by Beilstein and Kuhlberg. They are formed in about equal quantities, and are divided by the varied solubilities of the calcium salts.

F. JAPP and G. SCHULTZ has discovered "*Methyl-anthracen*, $C_{14}H_{19}.CH_3$," in small quantities, accompanying anthracen and phenanthren in coal-tar. Oxidation changed it into anthraquinon-carbonic acid, $C_{15}H_8O_4$.

OBITUARY.

JOHN JOSEPH GRIFFIN.

THE regret with which we record the death of Mr. John Joseph Griffin will be shared by many of our readers. By designing or manufacturing new apparatus for laboratory use, and by effecting improvements which the adoption of more accurate methods of analysis or more refined methods of research had rendered necessary, he contributed in no small degree to the advancement of chemical science.

He was born in London in 1802, and was brought up to the trade of bookseller in the well known firm of Messrs. Tegg and Co. When still a young man he set up in business for himself at Glasgow as bookseller and dealer in chemical apparatus; subsequently returning to London, where he established the firm of Messrs. Griffin and Sons. He was one of the founders of the Chemical Society, and author of several works in connection with the science—"Chemical Recreations," "Radical Theory in Chemistry," &c.—all of which have been reviewed in our pages. He died June 9th, aged 75, and was interred at Nunhead Cemetery.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—Permit me to correct some most erroneous impressions that must have arisen in connection with the above subject, owing to a communication from my brother, M. M. Pattison Muir, of Owens College, to you (CHEM. NEWS, vol. xxxv., p. 94).

Located as I am at the Antipodes your paper has but just come to hand; hence the delay in correcting the matter.

The experiments my brother speaks of were instituted and performed personally by Prof. Liversidge, some months before I became his private assistant. After I occupied that position I merely worked out the practical details of the later determinations, under the personal supervision of Prof. Liversidge, and the information conveyed to my brother in confidence, in a private letter, was never meant for publication. The results of the investigation belong to Prof. Liversidge, and not to me, as my brother's letter might lead your readers to imagine.—I am, &c.,

JNO. M. MUIR.

University, Sydney, N. S. W.,
May 27, 1877.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Gazzetta Chimica Italiana.
Anno vii., 1877, Fascicolo iv. e v.

Elasticity of Metals at Different Temperatures.—G. Pisati.—The concluding portion of a long memoir consisting chiefly of tables and formulæ.

On a New Acid extracted from "Lecanara atra."—E. Paterno and A. Oglialoro.—The lichen in question has been obtained from the mountains surrounding the western part of Palermo. The acid crystallises from its boiling solution in chloroform in small, colourless, transparent crystals. It is very sparingly soluble in cold ether and alcohol, dissolves rather more freely in benzol and alcohol at a boil. It is slightly soluble in cold chloroform, and moderately in the same medium when hot. It melts at 190°, and its composition may be expressed by the formula $C_{19}H_{18}O_8$. It has the characters of a feeble acid.

New Researches on Picrotoxin.—E. Paterno and A. Oglialoro.—The authors have obtained and analysed picrotoxide, $C_{15}H_{16}O_6$; mono-bromo-picrotoxide, $C_{15}H_{15}BrO_6$; the hydrate of picrotoxide, $C_{15}H_{18}O_7$.

Constitution of Chloral Ammonium and of Aldehydate of Ammonium.—R. Schiff.—In this paper, which is chiefly of a hypothetical character, the author treats of the preparation of chloral ammonium, its reaction with chloride of acetyl or anhydrous acetic acid; and the action of chloride of acetyl upon mono-acetyl-chloral ammonium.

Constitution of Cyanamid.—M. Filetti and R. Schiff.—This paper, which is also of a hypothetical nature, gives an account of the addition products of cyanamid with chloral.

Colouring-matter of "Boletus luridus."—Dr. G. Cugini.—In this preliminary paper the author gives the following conclusions:—That the chromatogenous matter of *Boletus luridus* is not aniline, as Phipson considers, and that it seems to be of an acid nature, and capable of yielding a blue salt with ammonia. Its most characteristic reactions are with ammonia and with iodine. It is completely insoluble in ether, and it seems to be the cause of the green colouration imparted to the substance of the fungus by the salts of iron and of tin.

Fluoride of Magnesium.—Alfonso Cossa.—After giving a survey of our previous knowledge of this compound, the author states its composition, as found in his analyses, as—

Magnesium ..	39·21	38·94	38·71
Fluorine	60·79	61·06	61·29
	100·00	100·00	100·00

corresponding to the formula MgF_2.

Colouring-matter of "Velella limbosa."—A. and G. De Negri.—Haxing studied the purple of the *Murex*, in which they have discovered indigotin and a red matter analogous to indigo-red, the authors had examined the blue colouring-matter of *Vellela limbosa*, an oceanic mollusk, sometimes driven on shore by the winds. The colouring-matter is blue with a slight purple cast, very fugitive, fading rapidly with the death of the animal. It is insoluble in ether, chloroform, benzol, and bisulphide of carbon, but dissolves in water, and the solution becomes yellow on boiling. Acids turn it red; alkalies render it an amethystine rose, which acids do not re-convert to the original blue. It is bleached by chloride of lime and by oxygenated turpentine; acetone and essence of bitter almonds turn it red. Its spectrum has nothing remarkable, and it is at once distinguished from the purple of the *Murex* and the colouring-matter of *Aplisia* by the absence of absorption-bands.

On an Easy Process for Detecting Minute Traces of Copper.—L. Cresti.

Electolytic Determination of Zinc and Lead in Minerals and in Artificial Products.—G. Parodi and A. Mascazzini.

These two papers are reserved for insertion in full.

Portable Apparatus for Volumetric Analysis.—F. Sestini.—The description of the apparatus cannot be made intelligible without the accompanying engraving.

MISCELLANEOUS.

The Supposed Mercurial Poisoning by Coloured Vulcanite.—An impression has long prevailed that it was possible for the salts of mercury, used to colour red vulcanite, to exert a poisonous influence where red rubber plates were worn in the mouth; and the attention of the

Odontological Society having been strongly drawn to the subject by Dr. Bathurst Woodman's papers (see *Trans. Odont. Soc.*, 1875), relating cases of supposed mercurial poisoning from this cause, a committee was appointed to collect evidence and report upon the subject. Their inquiries have however utterly failed to establish the existence of a single case of unquestionable, or even probable mercurial poisoning due to the use of red vulcanite plates. The committee requested Professor Attfield to make "an investigation of the influence, if any, of saliva and the other fluids of the human body on the pink and red varieties of vulcanite used by dentists in making artificial teeth-plates, gums, and palates." These tinted varieties of vulcanite are made by heating pink or red "dental rubber," under pressure, to a temperature of 310° to 315° F. (154° to 157° C.), the "dental rubber" being prepared by incorporating sulphur and vermillion with pure indiarubber. The following are the results of Dr. Attfield's investigation—1. So far as any action on man is concerned vermillion is a harmless substance. 2. So far as any effect or influence of the vermillion is concerned, the mixture of vermillion, sulphur, and indiarubber, commonly termed "dental rubber," is also a perfectly innocuous substance. 3. Pink or red dental vulcanite, even when placed under the severest conditions of experiment, does not yield any trace of mercury to saliva, or, indeed, to other far more powerful solvents. 4. The metallic pins and braces in dental vulcanite do not displace mercury, or induce the formation of any compound of mercury soluble in saliva or in more powerful solvents. Dr. Attfield is therefore of opinion that vermillion vulcanite teeth-plates are practically unaffected by saliva, or by any substance which ever gains access to the mouth; and, in short, that the pink and red vulcanite artificial gums and palates now so generally worn are absolutely harmless.

NOTES AND QUERIES.

Organic Principles of Plants.—Could you advise me a book which treats upon the organic constituents of plants in a thoroughly scientific manner? I have two very useful books but they hardly say enough on the subject; they are as follows:—"Schleiden's Botany" and "Schorlemmer's Chemistry of Carbon Compounds."

MEETINGS FOR THE WEEK.

SATURDAY, 23rd.—Physical, 3. "Applications of Melloni's Apparatus to Clifton's Optical Bench, and Interference of Light by Thick Plates," by Prof. W. G. Adams, F.R.S. (Adjourned Special General Meeting.)
MONDAY, 25th.—Royal Geographical, 8.30.
TUESDAY, 26th.—Anthropological Institute, 8
WEDNESDAY, 27th.—Society of Arts, 4. Anniversary.

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THE CHEMICAL NEWS.

VOL. XXXV. No. 918.

ON REPULSION RESULTING FROM RADIATION.—PART III.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 256.)

152. THE following experiments were tried with a very sensitive radiometer in a 2-inch bulb. The moving part (the "fly"), consisting of glass arms, pith disks, and steel point, weighed only 0·8 grain. It was exhausted with a charcoal reservoir attached (131).

A standard candle, placed 2 inches from the centre, made the arms spin with a velocity of 4 revolutions per second; with the candle 4 inches off the velocity was 10 revolutions in 11 seconds. In the full sunshine of a November day the speed was too great to count. Nothing was visible but an undefined nebulous ring, which became more or less distinct as the sunlight increased and diminished owing to passing clouds. This speed was kept up for more than an hour; indeed there appears no reason why it should ever diminish as long as light of uniform intensity shines on it.

153. The same radiometer was tried by the light of a candle, 4 inches off, behind different screens, with the following results:—

1 Candle, 4 inches off—	Seconds for 1 Revolution.
Naked flame	1·1
Behind thin white glass	1·3
" thick plate glass	1·4
" purple glass	1·5
" dark red glass	1·5
" pink glass	1·6
" light yellow glass	2·1
" blue glass	2·5
" orange glass	2·7
" green glass	3·0
" "eclipse" glasses (blue and orange, almost opaque to daylight	4·0
" 7½ millims. of water in cell	6·0
" solution chromate of potash, 7½ millims. thick	6·0
" sol. bichromate of potash, 7½ m.m. thick	7·0
" clear plate of alum, 5 m.m. thick	9·0
" sol. chloride of cobalt, 7½ m.m. thick	12·0
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" sol. ferricyanide of potassium, 7½ m.m. thick	30·0
" sol. sulphate of nickel, 7½ m.m. thick	35·0
" sol. sulphate of copper, 7½ m.m. thick	39·0

154. The instrument is thus seen to be capable of very extended use as a measurer of radiation of any desired kind. Unlike the instrument described in paragraph 135, it cannot be used for actually balancing one quality of light against another; and the method of taking an observation is not so accurate, for it is less easy to count revolutions per second or per minute than to observe the movement of a spot of light along a graduated scale. There are besides many causes which tend to interfere with the accuracy of the indications of this form of instrument. But, notwithstanding these drawbacks, I think the radiometer is likely to be a more popular form of light-measurer. It requires no adjustment, and is always ready to be observed, whilst there is a peculiar charm in using an instrument which is constantly in active work. With the exception of the comparison by balancing one light against another, all the observations mentioned in paragraph 140 can be taken with the radiometer, and it is besides capable of applications of its own. I will mention one, although others easily suggest themselves.

As the radiometer will revolve behind the orangecoloured glass used by photographers for admitting light into their so-called dark-room, it is only necessary to have one of these instruments in the window to enable the operator to see whether the light entering his room is likely to injure the sensitive surfaces there exposed; thus, having ascertained by experience that his plates are fogged or his paper injured when the revolutions exceed, say, one in three seconds, he will take care to draw down an extra blind when the revolutions approach that number. In photographic operations a radiometer may be placed in some convenient spot near the object to be copied. Having ascertained, once for all, how many revolutions the instrument makes whilst a good negative is being taken, the operator need in future take no account of the variation of light, but simply expose for the same number of revolutions, with a certainty that his negatives will all be of the same quality.

For the more important work of gas-testing probably the bar-instrument already described (135) will be more valuable; although, even for this purpose, the radiometer will he found to give very rapid and trustworthy indications.

155. I have already mentioned that the motion of the radiometer depends on a differential action of radiation on the black and white surfaces. To obtain rotation in the ordinary way the black must be repelled with more energy than the white; and this appears to be the case with all the luminous rays. In the case of dark heat, however, this difference of action is not apparent (128). The following experiments were tried with various radiometers:—

A candle was placed at such a distance from a radiometer that the fly would make one revolution a minute. A small glass flask of boiling water was then placed half an inch from the bulb. The revolutions instantly stopped, two of the arms setting equi-distant from the hot-water flask. The candle was kept in the same position, and the flask of water was removed. As the portion of the bulb which had been heated by the hot water cooled, the white surface gradually crept nearer and nearer to it, the superior repulsion of the candle on the black disks urging the arms round and acting in opposition to the repulsion of the hot glass to the white disk. At last the force of the light drove the white disk with difficulty past the hot spot of glass. Rotation then commenced, but for some revolutions there appeared to be a difficulty in the white disks passing the spot of glass which had been warmed by the hot water.

156. The flask of boiling water was then replaced in its position half an inch from the bulb of the radiometer. The rotation immediately stopped. The candle was then brought gradually nearer and nearer to the instrument, but with no particular effect. As it came very near the arms vibrated to and fro, and appeared to make violent efforts to get round, but no force of the light seemed sufficient to overcome the repugnance of the white disk to pass the heated portion of the glass.

157. The radiometer was allowed to cool, and the candle was again placed in the first position, where it produced one revolution in a minute. The finger was pressed against the side of the bulb. As the spot of glass got warm the white surface experienced more and more difficulty in getting past it, until at last one disk refused to pass, and the arms came to rest.

* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The instrument was again allowed to cool, and the revolutions re-commenced at the usual speed (the laboratory in which this was tried was somewhat cold). I then came from a warm room, and stood a foot from the radiometer, watching it. In about a minute the radiant heat from my body had warmed the side of the bulb nearest to me sufficiently to cause an appreciable difficulty in the movement, and soon the revolutions stopped. The same effect has been observed if the radiometer is brought into a very warm room, and placed near a cold window. If the daylight is feeble, the instrument not very sensitive, or an observer stands near the instrument, an appreciable sticking is observed as the white disks come near that part of the bulb which is the warmest.

These experiments show that dark heat has quite a different action from that of the luminous rays. They also show that many precautions are necessary to guard against the interfering action of unequal heating of the radiometer when it is being used for accurate measurements.

158. Having found such an antagonistic action of dark heat, I tried the action of ice. This, I have already shown (33, 88), is equivalent to warming the opposite side of the instrument. A piece of ice brought near the radiometer on one side cuts off the influx of heat to it from that side, and therefore allows an excess of heat to fall upon it from the opposite side.

The same radiometer that I used in the experiments with boiling water (155) was mounted with a candle the same distance off as before, so that one revolution took place in one minute. A lump of ice was now brought within half an inch from the bulb on the opposite side to the candle. The revolutions got slower, each arm as it passed seeming drawn toward the ice, and having a difficulty in moving away from it. At last the movement stopped altogether, an arm pointing direct to the ice, and being apparently held there by a powerful attractive force. Bringing the candle nearer caused the arms to oscillate a little; and when it was almost close to the bulb the force of the light overcame the action of the ice, and the arms revolved again, but irregularly and with jerks, the disks moving quickly to the ice and leaving it with difficulty. In this action of ice no preference was noticed for either the black or white surface.

159. A very delicate radiometer, in 2-inch bulb (152), was placed in a light just sufficient to see it distinctly by, but not enough to cause it to move. I then came out of a warm room and stood near it. In a few seconds it began to move slowly round, *but the motion was negative*, i.e., the black disks advanced instead of retreated—the action of the radiation of low intensity from my body being apparently to repel the white surface more than the black. On moving away from the instrument the rotation gradually stopptd. I now came near it again, and held one hand an inch from the bulb. Rotation soon commenced, but still in the reverse way. These experiments were repeated several times and on different evenings with the same results.

160. When the instrument was at rest I came quickly to it, and gently breathed on the bulb. There was a slight movement in the normal direction, but this stopped directly, and the arms commenced to revolve the negative way, and kept on in the same direction for more than a minute, performing three or four complete revolutions.

161. A glass shade 4 inches diameter was held over a gas-flame till the air inside was warm and the inner surface dim with steam. It was then inverted over the radiometer. Negative rotation commenced, and kept up for several minutes.

The glass shade was then dried inside, and heated uniformly before a fire, until it had a temperature of about 50° C. It was then inverted over the radiometer. Negative rotation instantly commenced, and kept up with for more than five minutes, diminishing in speed until the shade had cooled down to the temperature of the surrounding air.

162. The same experiment was repeated, and whilst the arms were in full rotation a lighted candle was slowly brought near it. When 3 feet off the negative rotation slackened. When the candle was about 2 feet off the arms became still, and when nearer than 2 feet the instrument rotated normally. The antagonism between the action of the hot shade and the lighted candle was perfect; by moving the candle to and fro it was easy to cause the radiometer to move in one direction or the other, or to become still. These experiments were repeated many times, always with the same result. The perfect obedience of the instrument to the opposing forces, according as one or the other was in excess, was very striking. I may mention that only some of my radiometers act in this manner. It seems to require extreme lightness and great perfection of vacuum. The movable parts of the radiometer which shows this action best only weigh 0·53 grain.

(To be continued.)

ON THE

DETERMINATION OF ALUMINA AND FERRIC OXIDE IN PRESENCE OF PHOSPHORIC ACID.

By M. H. PELLET.

To an acid liquid containing phosphoric acid, alumina, and ferric oxide, we add in excess chloride of calcium (the lime calculated in the state of $PO_5 3CaO$). We add ammonia; there is formed tribasic phosphate of lime, alumina, and oxide of iron. We calcine and weigh. The residue may be dissolved in hydrochloric acid and the phosphoric acid determined by uranium in a part of the liquid. In another part of the liquid we determine iron by protochloride of tin (F. Weil's process). From the weight of the iron we find Fe_2O_3, and from that of phosphoric acid $PO_5 3CaO$.

The difference between the weight of these two bodies and the original weight gives the alumina. If we cannot determine phosphoric acid by uranium the determination of this acid may be done by direct analysis. This process should be used only where it is necessary to determine the phosphoric acid, iron, and alumina, or, at least, phosphoric acid and alumina, the useless weight of the iron being determined very rapidly.

If, in the liquid containing PO_5, Al_2O_3, Fe_2O_3, we have sulphuric acid, we ought to separate this latter to avoid the possibility of sulphate of lime being precipitated along with $PO_5 3CaO$, Al_2O_3, and Fe_2O_3. The separation is effected by baryta. In the filtrate an excess of baryta is not injurious if we take care to add a salt of lime in sufficient quantity to precipitate all the phosphoric acid in the state of tricalcic phosphate.—*Bulletin de la Société Chimique de Paris.*

REPORT

ON THE METHODS EMPLOYED IN THE

ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

MODE OF STATING THE RESULTS.†

(Continued from p. 262.)

WITH the view of testing the relative accuracy of the different modifications of the platinum process when ap-

† Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E, Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

plied to the estimation of potassium in the form of pure chlorides, the following experiments were performed:—The letters P and W refer to the mode of taking the required quantity of chloride of potassium: P signifying pipette measurement and W the weighing of the solution used. In the former case the percentage of chloride of potassium was obtained by calculating the chloroplatinate precipitate to potassium chloride, dividing the result by 0·697, and multiplying by 100. When a weighed quantity of platinum chloride solution was employed the following equation was used for calculating the percentage of chloride of potassium found,—S is the weight of solution used and P that of the precipitate obtained.

$$\frac{P \times 0{\cdot}3056 \times 11 \times 100}{S} = \frac{P \times 3361}{S} = \text{percentage of KCl found.}$$

Results bracketed together in the following tables were obtained from experiments executed side by side.

TABLE I.

Results of Experiments on Pure Chloride of Potassium, using Considerable Excess of Platinum Solution.

Expt.	Process.	KCl taken.	Weight of Precipitate.	KCl Per cent.	
1.	I. Fresenius ..	0·70072	2·3039	100·48	W.
2.	„ ..	0·70490	2·3156	100·39	W.
3.	III. Frank and Berrand ..	0·70150	2·3092	100·60	W.
4.	„ ..	0·70310	2·3118	100·48	W.
5.	IV. Tatlock ..	0·69700	2·2793	99·94	P.
6.	„ ..	0·69700	2·2792	99·93	P.
7.	„ ..	0·69700	2·2787	99·91	P.
8.	„ ..	0·70118	2·2947	100·01	W.
9.	„ ..	0·70140	2·2945	99·98	W.

These results, as far as they go, are decidedly in favour of Tatlock's method, and conclusively prove that it is capable of great accuracy.

At a later period of the investigations it was supposed that the excessive results obtained by some of the methods might be due to the fact that a very considerable excess of platinum solution was employed, a condition not in accordance with the directions of Fresenius and of Frank, but essential to Tatlock's method. The experiments made to elucidate this point did not immediately succeed those already detailed, but it is convenient to record the results here rather than in another place.

In the following experiments the quantity of platinum solution employed was but slightly in excess of the amount required to convert the whole of the platinum into chloroplatinate:—

TABLE II.

Results of Experiments on Pure Chloride of Potassium by Processes I. *and* III., *Employing only a* Slight *Excess of Platinum Solution.*

Expt.	Process.	KCl taken.	Weight of Precipitate.	KCl Per cent.	
10.	I. Fresenius ..	0·70164	2·2915	99·81	W.
11.	„ ..	0·69996	2·2875	99·87	W.
12.	„ ..	0·70227	2·2947	99·85	W.
13.	„ ..	0·70114	2·2931	100·08	W.
14.	„ ..	0·70150	2·2985	100·18	W.
15.	„ ..	0·70741	2·3218	100·30	W.
16.	„ ..	0·70877	2·3262	100·30	W.
17.	III. Frank.. ..	0·20291	0·6633	99·90	W.
18.	„	0·20291	0·6637	99·97	W.
19.	„	0·20037	0·6573	100·25	W.
20.	„	0·20009	0·6553	100·05	W.
21.	„	0·20377	0·6677	100·13	W.
22.	„	0·20109	0·6576	100·23	W.

These results showed a great improvement, and indicated pretty clearly the importance of avoiding a large excess of platinum solution when alcohol only was employed for washing the chloro-platinate.

The following table shows the relative accuracy and limits of variation obtained in experiments on pure chloride of potassium by methods I., III., and IV.

TABLE III.

Analysis of the Results Obtained in the Estimation of Potassium when in the form of Pure Chloride.

Process.	No. of Expts.	Highest Result.	Lowest Result.	Average.
I. Fresenius—				
With *large* excess of platinum solution	2	100·48	100·39	100·44
With *slight* excess do. ..	7	100·30	99·81	100·06
II. Frank and Berrand—				
Large excess of Pt solution	2	100·60	100·48	100·54
Slight „ „ „	6	100·25	99·90	100·09
IV. Tatlock—				
Large excess of Pt solution	5	100·01	99·91	99·95

From these experiments, therefore, it was concluded that the method of estimating potassium by precipitation as chloro-platinate was very accurate when proper precautions were taken.

This conclusion is generally accepted, the chief discrepancies arising when mixed alkaline chlorides are analysed, the different methods then giving results which sometimes exhibit wide variations.

The following table shows the results obtained by the analysis of various mixtures of the pure chlorides of potassium and sodium:—

TABLE IV.

Results of Experiments on Mixtures of Pure Chlorides of Potassium and Sodium.

A. Using Considerable Excess of Platinum.

Expt.	Process.	KCl taken.	NaCl taken.	KCl Found per 100 parts taken.	
23.	I. Fresenius ..	0·3502	0·350	100·59	W.
24.	„ ..	0·3543	0·355	100·84	W.
25.	„ ..	0·3519	0·350	100·66	W.
26.	„ ..	0·3503	0·350	100·70	W.
27.	„ ..	0·3520	0·350	100·75	W.
28.	„ ..	0·3524	0·350	100·73	W.
29.	II. Fresenius mod.	0·6970	0·154	100·34	P.
30.	„ „	0·6970	0·154	100·54	P.
31.	„ „	0·6970	0·154	100·35	P.
32.	„ „	0·6970	0·154	100·46	P.
33.	„ „	0·3485	0·350	100·53	P.
34.	„ „	0·3485	0·350	100·99	P.
35.	„ „	0·3485	0·350	100·83	P.
36.	„ „	0·3485	0·350	100·47	P.
37.	„ „	0·3485	0·350	100·47	P.
38.	IV. Tatlock	0·6970	0·154	100·11	P.
39.	„	0·6970	0·154	100·19	P.
40.	„	0·6970	0·154	100·15	P.
41.	„	0·6970	0·154	100·25	P.
42.	„	0·3485	0·350	99·34	P.
43.	„	0·3485	0·350	99·20	P.
44.	„	0·3485	0·350	99·60	P.
45.	„	0·3485	0·350	99·44	P.
46.	„	0·3509	0·350	99·73	W.
47.	„	0·3510	0·350	99·82	W.
48.	„	0·3505	0·350	99·97	W.
*49.	„	0·7053	0·350	99·45	W.
*50.	„	0·7007	0·350	99·66	W.

* Experiments 49 and 50 were made on a special solution containing about 2 parts of KCl to one of NaCl. These two determinations were made by Mr. W. Galbraith, who has had much experience in the determination of potassium by Tatlock's method.

B. Using Slight Excess of Platinum, above that required to convert all the K and Na into chloro-platinates.

Expt.	Process.	KCl taken.	NaCl taken.	KCl Found per 100 parts taken.	
51.	I. Fresenius ..	0·35273	0·350	100·23	W.
52.	,, ..	0·35209	0·350	100·94	W.
53.	,, ..	0·35150	0·350	99·72	W.
54.	,, ..	0·35250	0·350	99·77	
55.	III. Frank & Berrand	0·20000	0·200	100·40	W.
56.	,, ,,	0·20123	0·200	100·30	
57.	,, ,,	0·20177	0·200	100·02	W.
58.	,, ,,	0·20064	0·200	100·28	
59.	,, ,,	0·20291	0·200	102·14	W.
60.	,, ,,	0·20359	0·200	102·09	

TABLE V.

Comparison of the Actual Composition of Mixtures of Potassium and Sodium Chlorides with the Results Obtained.

A. Large Excess of Platinum.

Expt.	Process.	KCl taken. p. c.	NaCl taken. p. c.	KCl obtained. p. c.	Error.
23.	I. Fresenius ..	50	50	50·29	+0·29
24.	,, ..	50	50	50·42	+0·42
25.	,, ..	50	50	50·33	+0·33
26.	,, ..	50	50	50·35	+0·35
27.	,, ..	50	50	50·37	+0·37
28.	,, ..	50	50	50·36	+0·36
	Average				+0·35
29.	II. Fresenius mod.	82	18	82·28	+0·28
30.	,, ..	82	18	82·44	+0·44
31.	,, ..	82	18	82·29	+0·29
32.	,, ..	82	18	82·38	+0·38
33.	,, ..	50	50	50·26	+0·26
34.	,, ..	50	50	50·49	+0·49
35.	,, ..	50	50	50·41	+0·41
36.	,, ..	50	50	50·23	+0·23
37.	,, ..	50	50	50·23	+0·23
	Average				+0·34
38.	IV. Tatlock ..	82	18	82·09	+0·09
39.	,, ..	82	18	82·15	+0·15
40.	,, ..	82	18	82·12	+0·12
41.	,, ..	82	18	82·20	+0·20
42.	,, ..	50	50	49·67	−0·33
43.	,, ..	50	50	49·60	−0·40
44.	,, ..	50	50	49 80	−0·20
45.	,, ..	50	50	49·72	−0·28
46.	,, ..	50	50	49·86	−0·14
47.	,, ..	50	50	49·91	−0·09
48.	,, ..	50	50	49·98	−0·02
49.	,, ..	67	33	66 63	−0·37
50.	,, ..	67	33	66·77	−0·23
	Average				−0·11

B. Slight Excess of Platinum.

Expt.	Process.	KCl taken. p. c.	NaCl taken. p. c.	KCl obtained. p. c.	Error.
51.	I. Fresenius ..	50	50	50·11	+0·11
52.	,, ..	50	50	50·47	+0·47
53.	,, ..	50	50	49·86	−0·14
54.	,, ..	50	50	49·88	−0·12
	Average				+0·08
55.	III. Frank	50	50	50·20	+0·20
56.	,, ..	50	50	50·15	+0·15
57.	,, ..	50	50	50·01	+0·01
58.	,, ..	50	50	50·14	+0·14
59.	,, ..	50	50	51·07	+1·07
60.	,, ..	50	50	51·04	+1·04
	Average				+0·43

To be continued.)]

ON THE DETERMINATION OF MANGANESE IN SPIEGELEISEN AND FERRO-MANGANESE.

By SERGIUS KERN, St. Petersburg.

In a late number of the CHEMICAL NEWS I mentioned that experiments were commenced in order to estimate the manganese in iron alloys by direct ignition of the powdered sample with ammonium chloride. Since then this process has been improved and found by experiment to suit well for technical purposes.

0·5 grm. of the specimen in a state of fine powder is intimately mixed with 6 grms. of ammonium chloride in a high platinum crucible, in which the mass is strongly ignited. Then by the following reaction the iron is converted into ferric chloride, which partly flies away and partly sublimes on the cover of the crucible:—

$$6NH_4Cl + Fe_2 = Fe_2Cl_6 + 6NH_3 + 3H_2.$$

When all the ammonium chloride is decomposed the cover is removed and the sublime crystals of ferric chloride are washed off from the cover by water. Into the crucible a new quantity of ammonium chloride is placed, and the mass is secondly ignited; this operation is repeated till the sublimation of ferric chloride ceases. The residue is dissolved in 25 c.c. of aqua regia, and next evaporated; the dry mass is mixed with a solution of 10 c.c. of hydrochloric acid in 15 c.c. of water, and resulting precipitate of silica is filtered off. The filtrate concentrated on a sand bath is poured into a platinum crucible, in which it is dried, and the resulting mass is next ignited to constancy in weight.

The remaining brownish-black compound is manganomanganic oxide (Mn_3O_4), which is weighed. This compound, as it is known, contains 72·05 per cent of manganese.

Obouchoff Steel Works.

OBSERVATIONS ON SOME XANTHATES. SEPARATION OF NICKEL AND COBALT.

By DR. T. L. PHIPSON.

THE reactions of pure xanthate of potash either in solution in water or in alcohol may become very useful in analytical chemistry. Xanthate of potash is easily prepared by means of alcohol, potash, and bisulphide of carbon; it crystallises easily, and may be kept in the crystalline state unaltered for an indefinite period in well-corked bottles. To use it as a reagent a small quantity is dissolved for the occasion in cold distilled water.

Xanthate of Copper forms a brilliant orange-yellow precipitate when the potash xanthate is added to cupric salts even very acid; it is a salt of protoxide. In neutral copper salts, or those which are slightly alkaline, a basic precipitate of a pale canary yellow is produced. Xanthate of copper is almost completely insoluble in water, slightly soluble in alcohol, and rather more so in sulphide of carbon. Nitric acid attacks and dissolves it easily. When dry it burns like tinder, emitting a garlic odour, and on paper this combustion occurs with a fine purple flame, having a deep border of emerald green. It is quite insoluble in ammonia (the basic salt yields some oxide). In this way xanthate of copper can easily be separated from other xanthates which are, on the contrary, easily soluble in ammonia.

Xanthate of Nickel forms a precipitate of a chocolate brown colour, almost insoluble in water, exceedingly soluble in ammonia.

Xanthate of Cobalt is a dark green precipitate, almost insoluble in ammonia, which circumstance allows it to be easily and rapidly detected in nickel solutions and separated from nickel. With certain precautions this separa-

tion is quantitative. The two metals are precipitated together by xanthate of potash solution, in the cold, added gradually and whilst stirring; the liquid being very slightly acid by hydrochloric acid. The precipitate is allowed to deposit completely, the supernatant liquid decanted off, and the nickel salt taken up by ammonia diluted with its own volume of water, which dissolves it instantaneously, leaving the xanthate of cobalt.

Xanthate of Zinc forms a brilliant white precipitate, very slightly soluble in water, much more so in alcohol, and in sulphide of carbon, extremely soluble in ammonia. The ease with which xanthate of zinc dissolves in ammonia enables us to separate it rapidly and completely from xanthates of *lead*, *copper*, *cobalt* and *indium*, &c.

The solutions of xanthate of nickel and xanthate of zinc in dilute ammonia yield crystals of double ammoniacal salts by exposure to the air. In contact with excess of ammonia these salts (at least that of zinc) appear to undergo decomposition. The nickel salt forms the finest crystals.

The insoluble xanthate, on being dissolved in fuming nitric acid, previously diluted, develops nitrous ether, the odour of which is perceived the moment the solution commences. This proves, according to my view, that the xanthates contain a molecule of ethyl.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 21, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors, the minutes of the previous meeting were read and confirmed. The PRESIDENT then announced the following grants from the Research Fund of the Society:—Mr. Johnson, £50 for researches on potassium tri-iodide; Dr. Wright, £50 for researches on chemical dynamics; Mr. Neison, £25 for researches on octyl compounds; Mr. C. Williams, £25; and Mr. G. Harrow, £10.

The list of presents to the library was then read by Dr. ARMSTRONG.

The following certificates were read for the first time:—Dr. G. Rühnemann and J. Hadkinson. The following gentlemen were then balloted for and duly elected, the balloting occupying the Society till 9 o'clock:—F. H. T. Allan, H. S. Bell, C. T. V. Buck, J. Y. Buchanan, Dr. A. E. N. Franchimont, J. Gardner, W. Lapraik, G. A. Milne, J. Napier, C. G. Neison, J. L. Nolters, J. H. Poland, I. Scarf, H. Senier, H. G. Stacey, S. G. Thomas, Beeby Thompson, F. W. Toms, A. Watt, W. Webster, jun., J. R. Young.

The SECRETARY then read a paper "*On Diamyl*," by H. GRIMSHAW. This substance was prepared from amyl bromide boiling at 119° to 123°. To 300 grms. of the bromide were gradually added 50 grms. of sodium, and the mixture finally raised to 140° to 150° C. for about six hours. On distilling, diamyl was obtained, which was dried and purified by fractional distillation. When pure it boiled at 168° C. at 751 m.m. By passing dry chlorine into the vapour of the boiling hydrocarbon the chloride was obtained, boiling at 198° to 213°. By heating the chloride in sealed tubes at 160° to 170° for about forty-eight hours with lead acetate and acetic acid an acetate was formed, boiling 198° to 215°, as a colourless mobile liquid of a fruity smell. On mixing this liquid with an excess of caustic potash and a little water, allowing to stand for twenty-four hours, and then boiling for six hours, an inverted condenser being attached, two alcohols were obtained, boiling at 202° to 203° and 211° to 213° respectively. They were light colourless liquids, having an agreeable orange-like odour. These two liquids were mixed, oxidised with bichromate of potash and sulphuric acid, and the acid distilled. The silver salt had the composition $C_2H_3O_2Ag$. Another acid, whose silver salt contained 63·66 per cent Ag, was obtained by the action of bichromate in the cold.

The next paper was read by the SECRETARY "*On the Action at a High Temperature of Certain Volatile Metallic Chlorides on Certain Hydrocarbons*," by WATSON SMITH. The author investigated the action of antimony trichloride and tin tetrachloride on naphthalin, benzene, and toluep, when these substances were severally passed into the state of vapour through red-hot tubes. Benzene was boiled, and the vapours passed through a flask containing boiling antimony trichloride; the mixed vapours then passed through a heated combustion-tube loosely filled with fragments of pumice and porcelain. The products of the reaction were passed into a receiver, connected with which was a Liebig's condenser. The contents of the receiver were returned to the benzene flask, a fresh quantity of trichloride added to the other flask, and the distillation repeated a second and third time. The reaction expected was—

$$6C_6H_6 + 2SbCl_3 = 3\left.\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\} + 6HCl.$$

The diphenyl was extracted from the residues, and purified. It melted at 70°, boiled at 243°. The yield of diphenyl by this process was much larger than that obtained by passing the vapour of benzene alone through a red-hot tube (*Proc. Lit. and Phil. Soc. Manchester*, 1871), but was not quite satisfactory, so the action of tetrachloride of tin was tried. 62·4 grms. of benzene were distilled with 52 grms. of the tetrachloride. A very large yield of diphenyl was obtained in one distillation, and very little benzene escaped decomposition. *Toluen and Antimony Trichloride* oils were obtained, boiling 270° to 320°, having very disagreeable odours resembling burnt cheese. *Naphthalin and Antimony Trichloride:* 77 grms. of naphthalin were distilled with 46 grms. trichloride, the mixed vapours being passed through a red-hot tube. The distillation was repeated three times. 15 to 16 grms. of trichloride being added, 37·4 grms. of a crude product were obtained by distillation. This yielded 24·2 grms. of yellow crystalline isodinaphthyl. *Naphthalin and Tin Tetrachloride:* some difficulty was experienced from the blocking of the tubes by the separated carbon, and a special form of apparatus had to be devised. A large yield of isodinaphthyl was obtained, but the process is not so convenient as when antimony trichloride is used. A reddish oil, boiling about 250° to 300°, resembling "red anthracen oil," and some quantity of a citron-yellow powder, were formed. (2.) *Isodinaphthyl Sulpho-Acids and Salts, with certain other Derivatives:* by heating 1 part of naphthalin with 5 parts of concentrated sulphuric acid for four hours to 140° to 150°, treating with barium or lead carbonate, and evaporating, a large yield of the soluble α barium or lead salt was obtained, the difficultly soluble β salts separating out during evaporation. By heating 4 parts of isodinaphthyl with 2 parts of concentrated sulphuric acid to 180° to 190° for five hours a large yield of the β acid was obtained with but little α acid. The α acid was prepared from the barium salt as minute, transparent, yellowish, slightly fluorescent scales, easily soluble in water and ether, slightly in absolute alcohol, insoluble in benzol: the lead salt is easily soluble in water and weak alcohol. The β acid resembles the α acid, but is less soluble; its lead salt is difficultly soluble in water. An oxydinaphthyl or phenyl, a nitro-substitution product, and a cyanogen derivative were prepared, and to some extent examined. (3.) *A New Dinaphthyl:* when naphthalin is submitted to a high temperature, either alone or in the presence of a volatile, easily decomposable chloride, a yellow substance soluble in petroleum spirit is formed, together with isodinaphthyl. In the purification of the crude isodinaphthyl by petroleum spirit a fine red solution was obtained, which by spontaneous evaporation yielded several crops of warty crystals. These were distilled, and

gave a transparent, light yellow, resinous distillate. By fractional crystallisation, and the expenditure of much time and trouble, the author succeeded in separating three substances melting at 75°, 147°, and 250° to 255° respectively. The body melting at 250° to 255° was present in very small quantities in brown transparent plates, and was soluble, with a magnificent blue fluorescence, in benzene or alcohol. The author believes it to be identical with Lossen and Otto's polymeric dinaphthyl (*Ann. Chem. Pharm.*, lxviii., 89, and cxlvii., 170, 181.) The body melting at 147° is an isomeric dinaphthyl, obtained also by Lossen by the action of manganese and sulphuric acid on naphthalin (*Ann. Chem. Pharm.*, lxviii., 71). It boils at 300°. The body melting at 75° is a third dinaphthyl. So three isomeric dinaphthyls are obtained by passing naphthalin, together with antimony trichloride, through a red-hot tube. The one melting at 187° is formed in the largest quantity, next the one melting at 75°, whilst only a small quantity of that melting at 147° is obtained. The three isomers are, then,—

Dinaphthyl. No. 1. Iso-dinaphthyl.
ββ.

Melts at 187°.
Crystallises most readily in beautiful rhombic plates.
Soluble with difficulty in alcohol and ether; with moderate facility in boiling petroleum spirit and benzol.

No. 2. Lossen's.
αα.

Melts at 147° (Smith); 154° (Lossen).
Crystallises readily; form variable, modified by impurities.
Soluble in alcohol and ether; easily in petroleum spirit and benzol.

No. 3.
αβ.

Melts at 75°.
Crystallises with much difficulty, requiring days or weeks.
Very soluble in alcohol, ether, benzol, and petroleum spirit.

In conclusion the author points out the interesting results to be obtained by gentle oxidation, chlorination, &c., of the above bodies, a subject which he intends to take up on an early occasion.

The next paper was "*On the Action of Alkaline Oxalates on the Earthy Carbonates, and of Solutions of Alkaline Carbonates on the Earthy Oxalates*," by WATSON SMITH. The author having observed that when a solution of ammonium oxalate was brought into contact with chalk or powdered marble an ammoniacal odour at once became apparent, set to work to measure the extent of this and similar reactions. Sodium oxalate in solution on calcium carbonate: if the reaction were complete, 5·3 grms. of sodium carbonate would have been formed; in the cold 1·05 grm. were obtained, = 19·83 per cent; boiling for three hours produced 1·2135 grm., or 22·90 per cent. Sodium carbonate solution on calcium oxalate in the cold: 16·07 per cent; boiled for thirty minutes, 52·34 per cent. Sodium oxalate in excess on powdered marble in the cold: 20·97 per cent; boiling, 26·00 per cent. Sodium carbonate in excess on calcium oxalate: cold, 13·09 per cent; boiling, 78·35 per cent. By treating the same portion of calcium carbonate with successive quantities of sodium oxalate 45·87 per cent of sodium carbonate were obtained, the action gradually ceasing. By treating the same quantity of calcium oxalate with successive portions of sodium carbonate 93·83 per cent was decomposed. Sodium oxalate on strontium carbonate: cold, 7·63 per cent; hot, 7·63 per cent. Sodium carbonate on strontium oxalate: cold, 57·24 per cent; hot, 79·96 per cent. Sodium oxalate on barium carbonate: cold, 4·84 per cent; hot, 4·97. Sodium carbonate on barium oxalate: cold, 73·20; hot, 87·96 per cent. Ammonium oxalate on calcium carbonate: cold, 12·27 per cent; with excess of oxalate, 13·53 per cent; with excess of carbonate, 19·94. Sodium oxalate on lead carbonate: cold, 6·35 per cent; hot, 13·08 per cent. Sodium carbonate on lead oxalate: cold, 81·54 per cent; hot, 90·61 per cent.

The next paper was entitled "*Note on Thallious Platinocyanide*," by R. J. FRISWELL and A. J. GREENAWAY. In 1871 one of the authors described a compound of thallious platinocyanide with thallious carbonate—

$$Tl_2PtCy_4,CO_3Tl_2,$$

crystallising in dark red crystals reflecting a green metallic light; by treatment with nitric acid colourless crystals were obtained having the formula—Tl_2PtCy_4. Carstanjen, however (*Journ. Pract. Chem.*, 102, p. 144, *Watts's Dict.*, Supp. ii., 1153), states that he obtained thallious platinocyanide in blood-red needles, having a metallic green lustre by reflected light. As this is not in accordance with the above statement the authors have reinvestigated the subject with great care. Hydroplatinocyanic acid was prepared, and neutralised with an equivalent quantity of thallious carbonate—

$$Tl_2CO_3 + H_2PtCy_4 = Tl_2PtCy_4 + CO_2 + OH_2,$$

a colourless neutral salt was obtained. On adding to it a fresh portion of the acid, twice the above amount of thallious carbonate, the dark red salt already described was obtained. Baric platinocyanide was also decomposed by thallious sulphate; the resulting crystals were quite colourless. The authors give the following analysis of the colourless thallious platinocyanide—

Pt, 28·09; C, 6·60 and 6·78; N, 7·76 and 7·91;

theory requires Pt, 27·82; C, 6·76; N, 7·89. These numbers show conclusively that the salt described by Carstanjen (especially as he gives no analysis) was really the double carbonate, and that thallious platinocyanide is a colourless compound.

The next paper was "*On Crystallised Barium Silicate*," by E. W. PREVOST. Pisani (*Comptes Rendus*, lxxxiii., 1056.) states that he has found the above substance attached to the sides of bottles in which barium hydrate solution had remained for several years; the author has obtained crystals formed under the same conditions, and having the same measurements, but containing only 0·78 per cent silica; they consist of barium hydrate, and contain 45·4 per cent water and 72·5 per cent barium; theory requires 45·6 per cent and 73·09 per cent.

The next paper was "*A Note on Anethol and its Homologues*," by W. H. PERKIN. The author mentioned that he had already (*Chem. Soc. Journ.*, 1877, 409-414) stated that methyl-paroxy-phenyl-acrylic, methyl-paroxy-phenyl-crotonic, and methyl-paroxy-benzyl-angelic acids, when heated, split up into carbonic acid and oily products; that from methyl-paroxy-phenyl-crotonic acid being supposed to be anethol, and those from the other acids homologues of that substance. Further experiments on this subject have since been made. On boiling *methyl-paroxy-phenyl-acrylic acid* in a bulb-tube provided with a side delivery tube, the heat being so moderated that a thermometer placed in the upper part of the tube does not rise above 220-240°, an oil gradually distils over, but after a time ceases, leaving a good deal of a dark coloured residue in the retort. The oil after purification gave numbers on analysis corresponding with the formula—

$$C_9H_{10}O = C_6H_4\begin{cases}(OCH_3)\\(CHCH_2)\end{cases}$$

When cooled in a freezing mixture it solidifies to a crystaline mass, having an odour and taste like fennel. When heated in a retort it rapidly changes, and before much has distilled over the principal part of it thickens, and on cooling forms a transparent nearly solid product; when oxidised it yields apparently anisic acid. *Methyl-paroxy-phenyl-crotonic acid* when distilled in the same manner as the above also yields an oil, but leaves less residue in the retort. This oil does not change much on distillation, and when fractionated begins to boil at 220°

the principal quantity, however, comes over between 230°-240°, leaving a little high boiling residue in the retort. Both of these fractions, when cooled in a freezing mixture, solidify, but the higher fraction freezes most readily and becomes harder; on pressing these products between bibulous paper, white crystals were obtained, which were purified by crystallisation from alcohol. This substance has the composition, melting and boiling points, as well as the taste, odour and appearance, of anethol. This indicates that the constitution of the C_3H_5 group in anethol has the constitution—

$$CH=CH-CH_3,$$

as will be seen, thus :—

$$\underbrace{C_6H_4(OCH_3)CH,CH,CH_2,COOH}_{\text{Methyl-paroxy-phenyl-crotonic acid.}} =$$

$$= \underbrace{C_6H_4\begin{matrix}OCH_3\\(CH,CH,CH_3)\end{matrix}}_{\text{Anethol.}} + CO_2$$

The author proposes to examine this body more critically when a sufficient quantity has been prepared. Methyl-paroxy-phenyl-angelic acid also when carefully distilled yields a crystalline anethol-like body as already mentioned in the paper previously referred to, but although there can be no doubt about its formula, it has not yet been obtained sufficiently pure for analysis.

Dr. ARMSTRONG thought that it was not at all proved that the C_3H_5 group had the constitution—

$$CH=CH-CH_3,$$

as isomeric changes might occur in the treating, and from other considerations it seemed much more probable that its constitution was $CH_2=CH-CH_2$.

The next paper was entitled "*Note on Persulphocyanic Acid*," by R. W. ATKINSON, Japan. The author commences by stating that the constitution of the above body is still uncertain, and points out the decompositions which must be indicated by its formula. The substance was prepared and purified by re-crystallisation from boiling water; its properties are described, also the precipitates produced by argentic nitrate, mercurous nitrate, and solution of iodine. Numerous experiments were made by adding varying quantities of argentic nitrate to the acid dissolved in alcohol, and evidence of the existence of $Ag_2C_2N_2S_3$ and $AgHC_2N_2S_3$ was obtained. When the yellow argentic persulphocyanate is boiled with water it quickly decomposes with effervescence, a heavy black precipitate being produced; attempts were made to determine the composition of this precipitate, but the results obtained vary widely. The general nature of the reaction is probably—

$$Ag_2C_2N_2S_3+3AgNO_3 =$$
$$= 2Ag_2S+AgCNS+CO_2+N_2O_4+N_2O_3$$

The mercurous salt is not apparently decomposed by boiling. In conclusion, the author points out the resemblance between the (probably correct) formula proposed by Glutz (*Deut. Chem. Ges.*, iii., 343) with that of parabanic acid.

The next paper was "*On the Oxidation Products of the Aloins*," by A. TILDEN, D.Sc. (Lond.) When nataloin is digested with 10 per cent. solution of bichromate of potassium, acidified with sulphuric acid, carbonic and acetic acids were alone obtained. If, however, barbatoin be similarly treated only a small quantity of acetic acid is formed, but a brown precipitate is deposited, this on analysis gave—C, 63·3 per cent; H, 3·2 per cent. The corresponding body from socaloin purified by solution in acetic ether gave—C, 63·8 per cent; H, 3·4 per cent. On treating in a rapid current of carbonic anhydride a yellow pulverulent sublimate, containing a few orange needles, was obtained. This re-crystallised from acetic ether gave C, 61·6 per cent; H, 3·4 per cent. The substances from socaloin and barbaloin are identical, and the author proposes the name of aloxanthin. This substance forms an orange granular powder, melting imperfectly at 260°-265°, subliming slowly at the same temperature in orange scales and dust. It is slightly soluble in water, very slightly in bisulphide of carbon, chloroform, alcohol, and ether. Its best solvents are ethyl acetate and glacial acetic acid. In caustic soda it dissolves to a bright cherry-red solution without absorption bands. Heated with zinc dust, a hydrocarbon, having a greenish fluorescence is obtained, melting at 203°-205°. This consists principally of methyl-anthracen. Aloxanthin fused with caustic potash forms an indigo blue mass; aloxanthin does not combine with merdants. Its formula is probably $C_{15}H_{10}O_6$, being a methyl-tetroxy-anthraquinon. Three analyses of the purest sample gave—C, 62·9; H, 3·3. Theory requires C, 62·9; H, 3·3 per cent. An acetyl compound was formed. Aloxanthin treated with fuming nitric acid in the cold yields a yellow nitro-acid, having the properties of aloetic acid.

The Society then adjourned over the vacation to Thursday, Nov. 1st.

PHYSICAL SOCIETY.

June 23rd, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

PROF. W. GRYLLS ADAMS exhibited and described a very complete form of optical bench, which, in addition to being provided with all the improvements introduced by Prof. Clifton, carries an arm which can be set at any angle to it, and is provided with appliances for studying a beam of light or radiant heat when it deviates from the main axis of the instrument. At the base of a pillar firmly clamped in any position in the manner adopted by Prof. Clifton, is fixed a horizontal graduated circle, and a vernier attached to a counterpoised arm, which rotates round the axis of this pillar, renders it possible to determine the angle made by the arm with the bench to one minute. At the upper extremity of the pillar is a steel pivot to which various appendages may be clamped, and immediately below this is a second graduated circle by which to determine the angular position of whatever is supported by the pillar. Mirrors, metallic surfaces, prisms, &c., may be placed on this pillar for the reflection, refraction, diffusion, or polarisation of heat and light. For radiant heat the rotating arm carries a line, thermo-electric pile, and a table on which absorbing media may be placed. Prof. Adams illustrated the use of the instrument by projecting on to a screen the interference bands obtained when a beam of light, after reflection from the two surfaces of a thick plate of glass, is again reflected from the two surfaces of a similar plate placed very nearly but not quite parallel to the first. A compensator consisting of two plates of glass of equal thickness is also added between the two thick plates, and an ingenious arrangement renders it possible to incline the glasses at any angle to one another, and to move them either independently or together. He also showed the delicate adjustment of which this compensator is susceptible and the effect produced in the positions of the bands when the rays from the two surfaces of the first plate traverse air of different densities before falling on the second. The adjustment of this latter was facilitated by fine screws supplemented by springs, which rendered it possible to give a slight movement to the plate in any direction by combining a motion of translation of the plate parallel to its reflecting faces with a motion of rotation about a vertical or horizontal axis.

Mr. F. D. BROWN exhibited an apparatus he has arranged in which to compare thermometers, and which is also applicable to other cases requiring a limited space to be retained at a perfectly uniform elevated temperature. From a

brass hemispherical boiler rises a tube of the same metal, 2 inches in diameter and about 2 feet long; the steam, after ascending through it, descends a metallic jacket surrounding it, whence it passes into a U-shaped condenser, and from this it is returned to the boiler. The upper end of the condenser is in connection with a large air-tight vessel forming the base of the apparatus, and in which any required degree of exhaustion can be maintained by the use of Lothar Meyer's form of pump. The thermometers are placed in tubes containing liquid, which pass within the wide brass tube at its upper end, and by varying the nature of the liquid in the boiler and the pressure to which it is subjected the boiling-point can be retained constant at any required temperature.

Dr. Guthrie and Mr. Akroyd communicated a paper on "*Electrical Selection.*" When a metal or other body is rubbed against some non-conducting substance like caoutchouc, electricity is developed, and the track of the metal, although invisible, may be readily made evident by sprinkling on the caoutchouc a mixture of red-lead and sulphur. This sieving, as is well known, imparts negative electricity to the sulphur and positive to the red-lead; hence, by a kind of electrical selection, that particular ingredient of the mixture is drawn to the metal track which possesses the opposite kind of electricity. Iron, for example, when rubbed against caoutchouc generates negative electricity, and, after sprinkling the powder, the iron track is revealed by the marked collection thereon of red-lead. A list of mixtures was given which may be used instead of the above, and it was shown that electrical selection may prove of use (1) in making an electrical diagnosis of the metals, (2) in certain experiments where the quadrant electrometer is objectionable, and (3) in teaching, where this instrument is often unavailable on account of its cost.

An adjourned Special General Meeting of the Society was then held, after which the meetings were adjourned until November next.

NOTICES OF BOOKS.

A Treatise on the Law relating to the Pollution and Obstruction of Water-courses, together with a Brief Summary of the Various Sources of Rivers Pollution. By Clement Higgins, M.A., F.C.S., Barrister-at-Law. London: Stevens and Haynes.

The pollution of rivers has its legal as well as its chemical aspect. In the work before us the part of the question is dealt with in a full and comprehensive manner, chemical considerations playing a mere secondary part. The book consists of two portions; the former being devoted to a consideration of the "Rivers Pollution Prevention Act" of 1876, and the latter to "Riparian Rights and their Protection."

In the former of these divisions an inquiry is instituted as to the meaning of the word "polluting," which has not been defined by the framers of the Act. As a matter of course, our old acquaintances, the "Recommendations" of the late Rivers Pollution Commissioners, crop up, and are weighed in the balance with a degree of impartiality no less rare than praiseworthy. One important omission, however, must be noted, viz., the absence in these Recommendations of any special prohibition of the admission of chromium compounds into a water-course. Save arsenic, on the one hand, and calcium, magnesium, potassium, and sodium on the other, all metals, poisonous or harmless, are placed on a level. Mr. Higgins also forgets that under the terms "organic carbon" and "organic nitrogen" are included substances respectively dissimilar in their susceptibility to decomposition and in the nature of the products formed.

To the critique that the "Recommendations" entirely disregard the proportion between the bulk of the polluting liquid and of the river into which it flows, we find appended the following curious remark:—"To this objection it may be answered that to do so would be practically impossible, as the bulk both of the polluting liquids and of the river are continually changing." To this we beg to demur altogether: the amount of sewage from a town, of refuse water from a dye- or print-works, &c., is substantially the same one year as another. Nor do we find such rivers as the Thames, the Clyde, or even the Aire, dwindle occasionally into mere brooks like the Soar, the Croal, or the Hebble. The question is, to what extent does an inflowing sewer affect the quality of the stream? Any code based on the lines of the Recommendations opens the door to evasions without end. As to the eminent chemists whose names are mentioned as having pronounced the "Recommendations" practicable, we cannot help asking how many of them have made the pollution of rivers or the treatment of sewage the object of special and independent investigation? The suggestions of Mr. Crookes that "the river itself should be the standard of purity," and that "no liquid should be allowed to be sent into a river if the liquid contains a greater percentage of impurity than the river itself," are declared "simple and practicable." It is further added that they would ultimately prove so effectual that they may be safely followed by County-court Judges in their decisions under the Act.

The remarks on the pollutions from paraffin-oil works are pefectly correct: neither by filtration, irrigation, or precipitation can these nuisances be dealt with, and their total exclusion from sewers should be insisted upon. The same rule applies to certain liquid refuse from india-rubber works. The introduction into the sewers of the liquid obtained by "ungumming" silks is a grievous waste, since its manurial value is very high.

Mr. Higgins reminds his readers that it is not the duty of the courts to advise defendants in what manner they may comply with the terms of an injunction, and that an allegation that a satisfactory mode of deodorising the sewage has not been selected will not justify failure in obeying the decree.

Proof that the best practicable and available means have been adopted for rendering harmless the sewage matter falling into a stream may be given either by the production of a certificate of an Inspector of the Local Government Board, "*which is conclusive,*" or by the production of scientific evidence, the conclusiveness of which seems to be an open question. We presume, therefore, that the Inspectors of the Local Government Board must be something more than mere men of science, and specially invested with infallibility. It is the more satisfactory to know this, as from certain recent disclosures the Board appear inclined to patronise cheap chemistry, a very fallacious article.

So far as we can, without presumption, venture to decide on the value of this book, we consider it a most important and welcome addition to the literature of what is generally known as the sewage question. We presume that few municipal authorities, sanitary boards, owners of land on the banks of rivers, &c., will neglect the opportunity now offered them of obtaining a clear view of the law of river-pollution.

Introduction to the Study of Chemical Philosophy. The Principles of Theoretical and Systematic Chemistry. By W. A. Tilden, D.Sc., F.C.S. London: Longmans, Green, & Co.

This work, which forms a member of the useful series of "Text-books of Science" issued by Messrs. Longmans, may be said to take the place once occupied by Dalton's on the Atomic Theory, embodying a general view of

chemical theory as it exists at the present time. The author treats successively of the constitution of matter, of fusion and solution, of liquid diffusion and dialysis, of evaporation, and ebullition, of gases, of the diffusion of dialysis of gases and their relation to temperature, and of spectra. He next proceeds to the consideration of elements and compounds, the laws of chemical combination, the the clasification of reactions, the distinction between compounds and mere mixtures, nomenclature, the condition of chemical change, theories regarding the nature of chemical attraction, and combustion. In a third section the student is introduced to equivalents and atomic weights, molecular weights and formulæ dissociation, types, atomicity, unsaturated compounds, and isomerism. The fourth and fifth sections are respectively devoted to the classification of the elements and of compounds. The simple bodies he divides into three groups, oxigenic or non-metallic, metalloids or imperfect metals, and true metals or basigenic elements. The second of these classes includes hydrogen, but we are glad to find that the author protests against the too common though illogical practice of giving the name metalloid to such bodies as oxygen, chlorine or fluorine. Silicon he leaves with boron and carbon in the first class.

At the end of each section are found appropriate exercises. The authors own method in teaching chemistry is to get "the more advanced classes to read it by small portions at a time, and to work out all the exercises." Such a course of study, however, he fully admits can be profitably undertaken only as the sequel to a series of of experimental lessons. The work may be pronounced a fair, clear, and sufficiently comprehensive view of chemical theories as at present generally accepted, and as such it may be recommended to all students who have already made themselves sufficiently familiar with the facts of the science.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Academié des Sciences. No. 21, May 21, 1877.

Gay-Lussac's Law of Volumes.—M. H. Sainte-Claire Deville.—Reserved for insertion in full.

Report on a Memoir by M. Stanislas Meunier entitled "Composition and Origin of the Diamond-Sand of Toit's Pan in South Africa.—MM. Des Cloizeaux and Daubrée.—The authors, whilst admitting that the diamond-rock has been raised up from below, do not consider that its elevation is due to volcanic action. The authors think that each of the rocks found filling the pans has been torn from a distinct bed, and conveyed separately to the place where they are now found in mixture. Hence these sands belong to the same class as the granitic sands found interposed among stratified deposits.

Use of Oxygen at High Pressure in Physiological Investigations.—M. P. Bert.—The author has shown that oxygen at high pressure rapidly destroys all living beings and of all anatomical elements. All those phenomena known as fermentation, where the action depends on the presence of living beings, such as acetification, putrefaction, &c., are completely arrested even by the transitory action of compressed oxygen, whilst fermentations due to a dissolved matter (diastase, emulsine, &c.) perfectly resist the influence. He has applied this action of compressed oxygen as a means of physiological investigation. He finds that the ripening of fruits is arrested by exposure to compressed oxygen, and is hence due to a cellular evolution. The poison of the scorpion, whether liquid or dried and re-dissolved in water, entirely resists the action of compressed oxygen. Such poisons owe their action to chemical compounds comparable to the vegetable alkaloids. Fresh vaccine matter submitted for more than a week to oxygen at a pressure equal to about 50 atmospheres retained its virtue. The matter of glanders, after similar treatment, rapidly killed horses inoculated therewith. Hence these kinds of virus do not owe their properties to living beings or living cellules. Carbuncular blood, also, after exposure to compressed oxygen, though freed from bacteria, nevertheless retained all its dangerous properties.

Use of Rotatory Discs for the Study of Sensations of Colour.—M. A. Rosenstiehl.—Reserved for insertion in full.

Oxalic Acid as a Characteriser for the Poly-atomic Alcohols, and on the Chemical Functions of Inosite.—M. Lorin.—The author's experiments with dehydrated oxalic acid give more extension to an easy and industrial preparation of formic acid in a high state of purity, and almost at its maximum degree of concentration, and furnish a new characteristic of the poly-atomic alcohols, among which must rank inosite.

Decomposition of Hydrochlorate of Trimethylamin by Heat.—M. Camille Vincent.—This compound may serve for the easy and abundant preparation, not merely of mono-methylamin, but also of chloride of methyl, yielding hydrochlorate of ammonia as a by-product. This decomposition may be utilised for causing the chloride of methyl to react at a high temperature, and in the nascent state, upon various bodies, and especially upon aniline. If we heat a mixture of hydrochlorate of trimethylamin and hydrochlorate of aniline we obtain methyl-aniline, which distils over, and which only requires to be washed with water and rectified. If thus prepared it is free from all traces of aniline. The hydrochlorate of trimethylamin, which is now obtained on the large scale, may thus be judiciously utilised for the preparation of ammoniacal products and of pure chloride of methyl, which latter may serve either in the manufacture of methylated aniline colours, or in the preparation of pure methylic alcohol.

Spectrum of the Electric Spark in a Compressed Gas.—M. A. Cazin.—The electric spark in a gas is analogous to the ordinary flame of a hydrocarbon. In each of these luminous sources there are gaseous particles which produce a spectrum of lines, and solid or liquid particles which produce a continuous spectrum. These are derived in case of the spark from the electrodes and the sides of the vessel when very near. When the pressure is increased these particles are more abundant, their continuous spectrum becomes more brilliant, and, finally, causes the disappearance of the linear spectrum of the gaseous particles. It is in the flash of fire that things take place thus; the paler luminous halo or aureola is formed of gaseous particles whose linear spectrum is more or less visible; it is to the entire spark what the blue base of the flame of a candle is to the entire flame. At ordinary pressures, in nitrogen, the spark is pale and furrowed with small flashes of fire. We see in the spectroscope the grooves ascribed to nitrogen, and in their intervals the characteristic lines of this gas. On compressing we see the grooves disappear little by little, whilst the continuous ground of the spectrum becomes more brilliant. When the pressure exceeds two atmospheres there are only six lines of nitrogen from the orange to the blue, and five diffused bands beyond. At 10 atmospheres there only remain the two nitrogen lines $\lambda = 567$ and $\lambda' = 500$, and then a very brilliant line in the violet $\lambda'' = 424$ which first appears at 5 atmospheres. The sodium line is very distinct, whilst it is not to be distinguished at ordinary pressures. About 15 atmospheres the spark becomes dazzling; upon the continuous spectrum are seen the four lines above mentioned, and certain brilliant points due to platinum. In air compressed above

30 atmospheres the spark produces intense reddish vapours, and the spectrum showed the absorption spectrum of hyponitric acid.

Certain New Forms of the Radiometer.—Mr. W. Crookes.—The contents of this paper are known to English readers.

Thermo-Chemical Researches on Aniline and certain other Bodies of the same Group.—M. W. Longuinine.—It appears from these experiments that aniline is a feebler base than ammonia, which, in the cold, displaces it entirely, or nearly so. Toluydin is not displaced by aniline in notable quantity from its combination with hydrochloric acid.

Nitrates of Bismuth.—M. Yvon.—The acid nitrate of bismuth however crystallised presents the composition $BiO_3,3NO_5,11HO$. The sub-nitrate was obtained by decomposing the acid salt with 16 parts of water. Both the first precipitate and that from the 12th, 13th, and 14th washings showed the constant composition—

$$5BiO_3NO_56BiO_3HO.$$

The sub-nitrate obtained in regular brilliant oblique prisms with rhombo-hedral bases, corresponds with the formula, $BiO_3NO_5\frac{1}{2}HO$.

Properties of Resorcin and its Molecular Volumes.—M. L. Calderon.—An attempt to calculate the molecular volume of dissolved resorcin.

No. 22, May 28, 1877.

Gay-Lussac's Law of Volumes.—M. A. Würtz.

Reply to a Note by M. Würtz relating to the Law of Avogadro and the Atomic Theory.—M. Berthelot.—These two papers, which will be inserted in full if possible, are contributions to the dispute now going on between MM. Würtz and Sainte-Claire Deville.

Researches on the Substituted Eugenols.—M. A. Cahours.—This paper contains a description of ethylen-eugenol, a body formed during the reciprocal action of dibromide of ethylen and potassic eugenol, and of its immediately higher homologue propylen-eugenol.

Thermic Researches on the Substituted Anilines. M. W. Louguinine.—The compounds examined are the three chlorated anilines (ortho, meta, and para), paranitro aniline. The author draws the following conclusions:—The heat liberated in the combination of the aniline group studied is diminished in a striking manner when one atom of hydrogen is replaced by one electro-negative atom or group; the decrease is especially considerable for the nitro-derivative. In the same substitution there is a diminution of the resistance of the salt formed with HCl to the action of an excess of water. The toluidin (para) dissolved liberates in its combinations with acids rather more heat than aniline, and its salts are more stable under the influence of an excess of water. In the anhydrous state the results are not comparable, the aniline being liquid and the paratoluidin solid. Several of the derived anilines give rise to the same difficulty. The various bases, isomers of mono-chlor-aniline, do not liberate the same quantities of heat on combining with acids. When all is dissolved the para-base liberates the most.

Electrolysis of Ordinary Pyro-tartaric Acid.—MM. E. Reboul and E. Bourgoin.—Ordinary pyro-tartaric acid is very stable and undergoes electrolysis after the manner of a mineral acid. It differs in this respect from succinic acid, whose tolerably alkaline solution is easily decomposed into ethylen and carbonic acid. It may rank with the phthalic and camphoric acid.

Researches on the Synthesis of Acids of the Series $C_nH_{2n-2}O_2$ and $C_nH_{2n-4}O_4$.—E. Reboul.—Not adapted for abstraction.

Decomposition of Carbonic Acid in the Solar Spectrum by the Green Parts of Plants.—M. C. Timiriazeff.—In the reduction of carbonic acid by the green parts of plants the solar rays act in the ratio of their energy and of the elective absorption by chlorophyll.

Reimann's Färber Zeitung, No. 18, 1877.

At a meeting of the Berlin Dyer's Association, held on May 4th, a paper was read on the importance of technical schools, and an interesting discussion took place, the prevalent opinion being that the branches of trade concerned ought not to depend upon the aid of Government, but take the matter into their own hands.

An aqueous solution of eosin is recommended as a red ink.

No. 19, 1877.

The editor calls attention to the fact that tissues, especially woollen, which have been for a long time exposed to air and light, acquire a stronger affinity for colouring matters than portions of the same material which have been kept in the dark. This circumstance often renders the production of a level shade in garment dyeing simply impossible, those parts upon which the light has chiefly fallen always taking the dye more readily, and coming up as dark stripes or spots.

Les Mondes, Revue Hebdomadaire des Sciences, No. 3, May 17, 1877.

According to the French *Nature* Druidical practices are not entirely extinct in Bretagne, and the clergy are consequently very anxious to destroy the menhirs.

Father Secchi is said to have invented a new electric sismograph in which paper blackened with smoke is set in motion, and which indicates the direction, number, intensity, and duration of shocks, and many other details.

No. 4, May 24, 1877.

In an article on the "Extravagances of Science," levelled at the *Revue Scientifique*, Professor Haeckel is designated as the "leader of atheistic science beyond the Rhine."

The ordinary phosphate of soda is strongly recommended as a remedy for debility, and especially for pulmonary consumption.

No. 6, June 7, 1877.

This issue contains no original chemical matter.

MISCELLANEOUS.

The Emperor of Brazil.—On Saturday morning last His Imperial Majesty, the Emperor of Brazil, honoured Mr. Crookes, F.R.S., with a visit, at his house in Mornington Road, where he remained some time examining the various forms of Radiometers, and witnessing some experiments on Repulsion resulting from Radiation.

Sanitary Institute of Great Britain.—A meeting of the Institute will be held in the Lecture Theatre of the Royal Institution on Thursday, July 5, at 4 o'clock p.m. The Duke of Northumberland, K.G., D.C.L., President, in the chair. Dr. B. W. Richardson, F.R.S., will deliver a Lecture on "The Future of Sanitary Science—in Relation to Political, Medical, and Social Progress."

Trade Marks.—A fortnightly journal specially devoted to all matters connected with British, Colonial, and Foreign Trade Marks, and for the promotion of a complete system of International Registration, is announced to appear on July 2, with the title "Trade Marks."

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

MAY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia. Saline.	Ammonia. Organic.	Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale. Before Boiling.	Hardness on Clark's Scale. After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs
Thames Water Companies.												
Grand Junction	Slightly turbid	0·001	0·007	0·135	0·049	20·50	8·550	0·460	0·80	1·670	13·2	3·3
West Middlesex	Slightly turbid	0·000	0·007	0·150	0·059	20·20	8·540	0·460	0·87	1·670	13·2	4·2
Southwark and Vauxhall	Clear	0·001	0·008	0·150	0·052	19·60	8·490	0·460	0·87	1·680	13·2	3·3
Chelsea	Clear	0·000	0·007	0·135	0·052	20·10	8·210	0·500	0·94	1·740	13·2	3·3
Lambeth	Slightly turbid	0·000	0·008	0·180	0·053	21·00	8·600	0·610	0·87	1·006	13·7	3·7
Other Companies.												
Kent	Clear	0·000	0·002	0·420	0·003	31·00	12·320	0·610	1·59	4·530	19·4	6·5
New River	Clear	0·000	0·006	0·138	0·036	19·40	8·160	0·500	0·87	1·800	12·6	3·3
East London	Clear	0·000	0·007	0·180	0·028	18·80	8·660	0·500	1·01	1·930	11·6	3·3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

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Orange Sulphide of Antimony.—In what manner is the "orange red sulphide of antimony" as used by india-rubber manufacturers obtained from the "black" commercial sulphide of antimony?—J. M CROSSAN.

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ERRATA.—Page 257, col. 1, line 44 from top, page 258, col. 1, line 13 from top, and col. 2, line 23 from top, *for* "heated" *read* "treated."

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